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# Atmospheric Transmission of Laser Radiation: Computer Code LASER

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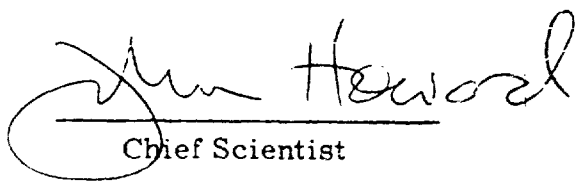

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A computer code called LASER has been developed and documented and will be made available to interested users. LASER is a version of HITRAN which computes the monochromatic extinction coefficients for both molecular and particulate components of the atmosphere and provides results for a series of atmospheric models from sea level to 100 km in altitude. A detailed description of the calculations leading to these extinction coefficient charts is

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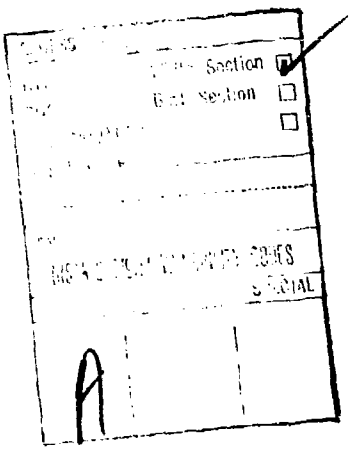
provided, and charts are provided for a number of specific laser frequencies in order to bring up to date previously published results. In addition, high spectral resolution atmospheric transmission spectra have been provided covering the regions of $CO_2$, CO, and DF laser emission. These plotted spectra represent an up-to-date version of previously published material.

## Acknowledgment

The authors wish to acknowledge the work done by John Selby and James Chetwynd in the early stages of LASER program development. They also wish to acknowledge the contribution made by Eric Shettle and Robert Fenn in providing the aerosol models contained in the LASER program prior to their publication in a separate report.



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# Atmospheric Transmission of Laser Radiation: Computer Code LASER

## 1. INTRODUCTION

Several years ago, the development of lasers as sources of coherent, monochromatic radiation led to the need for understanding the propagation characteristics of the atmosphere at high spectral resolution. Fortunately, a wealth of basic experimental and theoretical work existed in the scientific literature and was already in the process of being compiled to form a data base[1] essential to the development of atmospheric transmission models pertinent to laser propagation. This data compilation is essential to address the problem of molecular absorption by discrete absorption lines of atmospheric molecules. Absorption line widths of such atmospheric molecules are typically of the order of 0.1 $cm^{-1}$ at one atmosphere pressure, and decrease with pressure. Thus, a computational spectral resolution of better than 0.1 $cm^{-1}$ is required.

Although discrete absorption lines form the most highly frequency-dependent portion of the atmospheric extinction coefficient, it is necessary, in addition, to consider extinction due to scattering by the molecules composing the atmosphere and extinction due to both scattering and absorption by aerosols (particulates) in

(Received for publication 31 January 1978)

1. McClatchey, R.A., Benedict, W.S., Clough, S.A. et al. (1974) AFCRL Atmospheric Absorption Line Parameters Compilation, AFCRL-TR-73-0096.

the atmosphere. These four extinction coefficients add to form the total extinction coefficient as indicated in Eq. (1)

$$\gamma = k_m + \sigma_m + k_a + \sigma_a \tag{1}$$

where $k_m$, $\sigma_m$ $k_a$, $\sigma_a$ are extinction coefficients due to molecular absorption, molecular scattering, aerosol absorption, and aerosol scattering, respectively. With the exception of molecular absorption, the remaining extinction mechanisms all result in rather slowly varying functions of frequency and so can be dealt with somewhat differently from the molecular absorption effects.

A series of reports[2, 3, 4] was published in an effort to provide the extinction coefficients expressed in Eq. (1) for a number of different atmospheric paths and for a large number of different laser emission lines. In addition to providing specific extinction coefficient information, high resolution spectra were published covering the entire spectral region from 0.76 to 31.25 μm,[5] using a version of the AFGL HITRAN computer code. This combination of extinction coefficients for specific atmospheric models and high resolution spectra has gone a long way to provide the systems analyst with some idea of the atmospheric extinction effects on any laser system in this spectral region.

However, there still appears to be a need for the user of this material to be able to consider laser frequencies other than those specific ones for which results were published and to consider alternative atmospheric models. The ability to interpolate within and to extrapolate beyond the published results is admittedly difficult and in some cases not very accurate. Therefore, we are using this report as a means of making available a computer code which can be used to generate extinction coefficients for the propagation of laser radiation through the atmosphere. As a result of modifications to all elements (except molecular scattering) of the extinction coefficients, we are providing a limited number of revised extinction charts for some of the same laser lines previously published. In view of the high interest in the propagation through the atmosphere of several laser systems, we are publishing revised high resolution spectra in the regions from 3.3 to 4.2 μm, 4.6 to 5.3 μm, and 7.1 to 13.5 μm. We have made every effort to

2. McClatchey, R.A. (1970) Atmospheric Attenuation of CO Laser Radiation, AFCRL-71-0370, ERP 359.

3. McClatchey, R.A., and Selby, J.E.A. (1972a) Atmospheric Attenuation of HF and DF Laser Radiation, AFCRL-72-0312, ERP 400.

4. McClatchey, R.A., and Selby, J.E.A. (1972b) Atmospheric Transmittance, 7-30 μm: Attenuation of $CO_2$ Laser Radiation, AFCRL-72-0611, ERP 419.

5. McClatchey, R.A., and Selby, J.E.A. (1974) Atmospheric Attenuation of Laser Radiation from 0.76 to 31.25 μm, AFCRL-TR-74-0003, ERP 460.

simplify and document the computer code, LASER, contained in Appendix A. This code is a special version of our AFGL HITRAN code specifically applicable to monochromatic, laser extinction coefficient calculations.*

## 2. MOLECULAR EXTINCTION

As indicated in the foregoing section, the process of molecular absorption by discrete absorption lines produces absorption coefficients that vary rapidly with frequency. In addition to this process, there are absorption processes that give rise to more smoothly varying absorption coefficients. Some examples are the "continuum" absorption by water vapor of particular significance in the atmospheric "windows" between 3 and 5 $\mu$m and also between 8 and 14 $\mu$m. We also have a slowly varying absorption caused by the nitrogen molecule ($N_2$) between about 3 and 4 $\mu$m. Let us indicate the form of the molecular scattering (Rayleigh) function used in our calculations, before considering these absorption effects. The extinction coefficient due to molecular scattering is given by Eq. (2) where p and T are the pressure (mb) and temperature (k) of the atmospheric path and $\nu$ is the frequency in wavenumbers ($cm^{-1}$).

$$\sigma_m = 9.807 \times 10^{-20} \left(\frac{273}{T}\right)\left(\frac{p}{1013}\right) \nu^{4.0117} \ (km^{-1}) \qquad (2)$$

This expression was obtained as a best fit to molecular scattering coefficients published by Penndorf[6] and is shown in Figure 1. In our model, it is necessary to integrate the density (p/T) through the atmospheric layer in question in order to represent more accurately the changing density with height. Due to the small variations in molecular scattering for different atmospheric models, the LASER program provides results for only one of the six standard input model atmospheres (see Appendix B).

During the past seven years since our first publication of laser transmission models, there have been numerous improvements in the molecular data base which forms the foundation of these calculations. We cannot possibly specify each of these improvements, but we have tried to keep the scientific community posted

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*A card deck for this computer program can be obtained by writing to the National Climatic Center, Federal Building, Asheville, N.C. 28801 for a charge of $20.00. The AFGL Atmospheric Absorption Line Parameters data tape required as input data can also be obtained from the same address for a charge of $60.00.

6. Penndorf, R. (1956) Luminous and Spectral Reflectance as Well as Colors of Natural Objects, Geophysical Research Paper No. 44, AFCRC-TR-56-203.

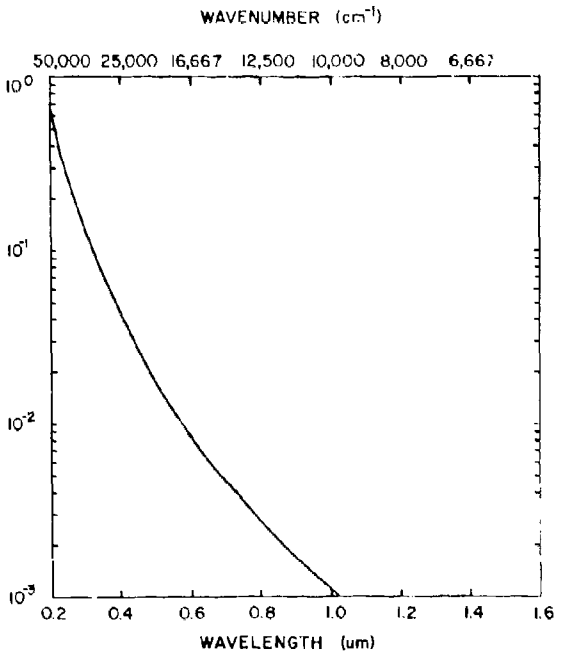


Figure 1. Molecular Scattering Coefficients at STP

through meetings and publications in the open literature.[7,8] The results of these improvements have been incorporated on the AFGL Atmospheric Absorption Line Parameters Compilation and made available through the National Climatic Center (see Section 1). Some substantial modifications to previous results arising from absorption line modifications have been made in the region between 3 and 4 micrometers as a result of improvements in HDO and methane line parameters. These improvements are reflected in some of the results included in this report.

There has been considerable controversy during the past two years regarding the water vapor "continuum" absorption, particularly in the 8 to 14-μm region, but also in the 3 to 5-μm region. As of this writing, existing laboratory measurements have been analyzed thoroughly; the resulting coefficients described here have been included in all results and in Appendix B where the LASER computer code is presented.

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7. Rothman, L.S., and McClatchey, R.A. (1976) Updating of the AFCRL Atmospheric Absorption Line Parameters Compilation, Applied Opt. 15:2616.

8. Rothman, L.S. (1977) Atmospheric Optics, OSA Technical Group Meeting, Tucson, 19 October 1976, Applied Opt. 16(No.2):277.

The absorption coefficient per precipital centimeter of water vapor is given in Eq. (3).

$$k_{m\ (Cont.)}^{(\nu, T)} = C_s(\nu, T)\, P_s + C_N(\nu, T)\, P_N \quad , \tag{3}$$

where $C_s(\nu, T)$ is a self-broadening coefficient due to collisions of water molecules with other water molecules; $C_N(\nu, T)$ is a nitrogen broadening coefficient due to collisions of water molecules with air (primarily nitrogen) molecules; $P_s$ is the partial pressure (in atmospheres) of water vapor, and $P_N$ is the partial pressure of the remainder of the atmosphere (primarily nitrogen). It is necessary to establish the $C_s$ and the $C_N$ quantities and their frequency and temperature dependence in both the 8 to 14- and 3 to 5-$\mu$m regions.

(i) The 8 to 14 micrometer continuum[7,8]

$$C_s(\nu, T) = C_s(\nu, 296) \exp\left(1800\left(\frac{1}{T} - \frac{1}{296}\right)\right)$$

where $C_s(\nu, 296) = 4.18 + 5578 \exp(-7.87 \times 10^{-3}\, \nu)$(pr. cm)$^{-1}$ atm$^{-1}$ and $C_N(\nu, T) = 0.002 \times C_s(\nu, 296)$(pr. cm)$^{-1}$ atm$^{-1}$.

(ii) The 3.5-4.2 micrometer continuum[8]

$$C_s(\nu, T) = C_s(\nu, 296) \exp\left(1350\left(\frac{1}{T} - \frac{1}{296}\right)\right) \text{ (pr. cm)}^{-1} \text{ atm}^{-1}$$

$$C_N(\nu, T) = 0.12 \times C_s(\nu, T)$$

where the $C_s(\nu, 296)$ values are given in Table 1.

Table 1. Self-Broadening Absorption Coefficients for Water Vapor Continuum (3.3-4.2 $\mu$m)

| $\nu$ (cm$^{-1}$) | ($C_s(\nu, 296)$(pr. cm$^{-1}$)(atm$^{-1}$) | $\nu$ | $C_s(\nu, 296)$(pr. cm$^{-1}$)(atm$^{-1}$) |
|---|---|---|---|
| 2350 | 0.230 | 2700 | 0.120 |
| 2400 | 0.187 | 2750 | 0.147 |
| 2450 | 0.147 | 2800 | 0.174 |
| 2500 | 0.117 | 2850 | 0.200 |
| 2550 | 0.097 | 2900 | 0.240 |
| 2600 | 0.087 | 2950 | 0.280 |
| 2650 | 0.100 | 3000 | 0.330 |

Using these continuum functions and the atmospheric models described in Section 4, we have Figure 2 drawn to show the relative effects of the water vapor continuum at 4 and 10 $\mu$m.

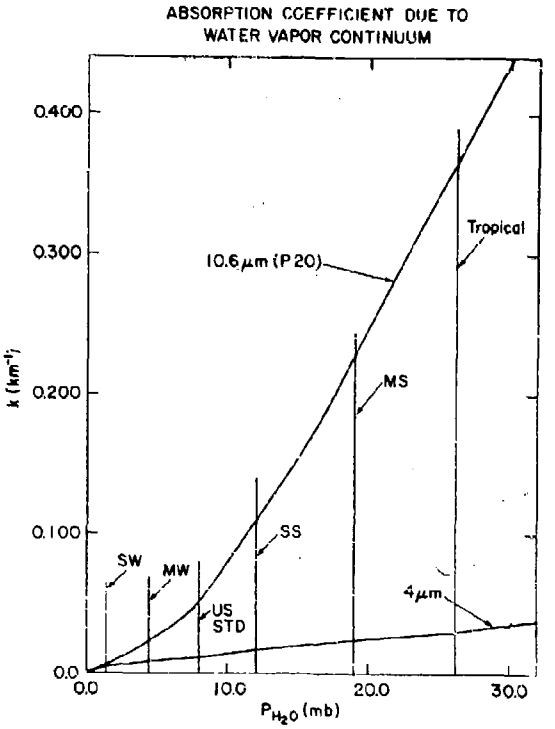


Figure 2. Absorption Coefficient Due to Water Vapor Continuum for Standard Meteorological Models: MS = Midlatitude Summer; SS = Subarctic Summer; US STD = U.S. Standard Atmosphere, 1962; MW = Midlatitude Winter; SW = Subarctic Winter (see Table 5)

In addition to the more or less continuous absorption due to water vapor as described, there is another quasi-continuous absorption feature due to molecular absorption by the nitrogen molecule centered near 4.3 $\mu$m (2350 $cm^{-1}$). In the spectral region from 2400 $cm^{-1}$ to about 2800 $cm^{-1}$, this absorption feature is of particular importance to laser transmission, as it tends to provide a background transmission level for paths in the lower atmosphere regardless of the presence or absence of absorption lines and regardless of how dry the atmosphere may be. It is of little importance at frequencies smaller than 2400 $cm^{-1}$ due to the overwhelming absorption by atmospheric carbon dioxide. Figure 3 represents the

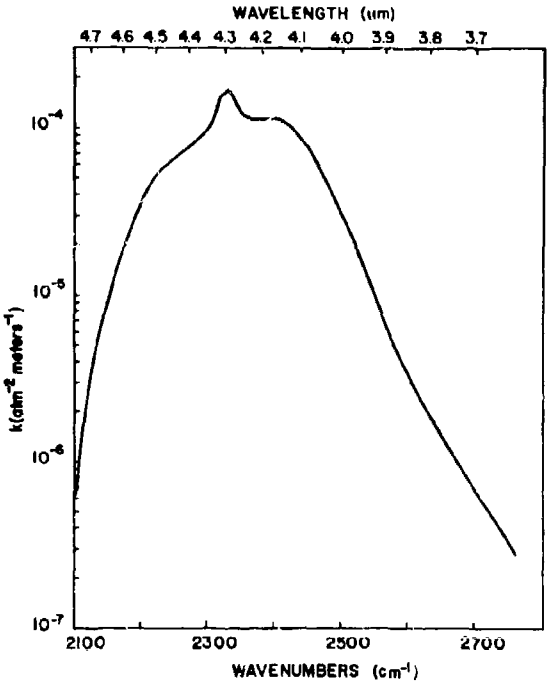


Figure 3. Absorption Coefficient Due to the Pressure-Induced Nitrogen Band at 4.3 μm

absorption coefficient as a function of frequency for this nitrogen absorption as contained in the LASER computer program in Appendix B.

In addition to these "continuum absorption" features, there is another issue accounting for much of the uncertainty due to molecular absorption in laser extinction computations. The problem is related to an accurate description of absorption line wings beyond 10 or 20 cm$^{-1}$ from absorption line centers. Indeed, in some cases uncertainties begin to arise within only a few wavenumbers of the centers of absorption lines. In our calculations and in the LASER program, we have truncated all line wings at 20 cm$^{-1}$ from line centers. In the lower atmosphere, all lines have been assumed to follow the Lorentz line profile, except that carbon dioxide lines have been modified by multiplication by the $\chi$ factor given in Table 2. This factor arises from analysis of measurements made by Burch et al.[9] Measurements of Long et al[10] and others provide evidence that water vapor lines should

9. Burch, D.E. (1970) Semiannual Technical Report, Investigation of the Absorption of Infrared Radiation by Atmospheric Gases, U-4784.

10. Long, R.K., Mills, F.S., and Trusty, G.L. (1973) Experimental Absorption Coefficients for Eleven CO Laser Lines, RADC-TR-73.

Table 2. The "χ" Factor Modification to the Lorentz Line Profile for $CO_2$ Lines

| $\nu - \nu_o$ | χ | $\nu - \nu_o$ | χ |
|---|---|---|---|
| 0 | 1.0 | 1.5 | 0.50 |
| 0.5 | 1.0 | 2.0 | 0.41 |
| 0.6 | 0.96 | 2.5 | 0.34 |
| 0.7 | 0.89 | 3.0 | 0.31 |
| 0.8 | 0.82 | 5.0 | 0.29 |
| 0.9 | 0.77 | 8.0 | 0.23 |
| 1.0 | 0.70 | 10.0 | 0.19 |
| 1.2 | 0.60 | 15.0 | 0.00 |

be represented by some "super-Lorentz" function, but as of the present, this remains one of the major unresolved problems of molecular spectroscopy. In any event, in regions where extinction coefficients are small, the contributions of line wings will be small and the empirically derived continua described here will dominate the molecular absorption between absorption lines. In spectral regions where line wings are more significant, the total extinction will be large, so the uncertainty in extinction coefficient will increase. However, in most cases, the existence of large extinction coefficients for atmospheric propagation will reduce the interest in developing systems operating at these wavelengths in the first place.

In the interest of developing a consistent set of AFGL Atmospheric Transmission Models, the continuum absorption for water vapor and nitrogen described in the preceding paragraphs is identical to the continuum models used in the most recent LOWTRAN model (LOWTRAN 3B).[11] This is possible in the case of the continuum absorption as it is fundamentally described by slowly varying (low resolution) functions.

## 3. AEROSOL EXTINCTION

Aerosols produce yet another rather continuous or slowly varying set of extinction coefficients throughout the visible and infrared spectral regions. Although there are some spectral features associated with aerosol extinction, this

11. Selby, J.E.A., Shettle, E.P. and McClatchey, R.A. (1976) Atmospheric Transmittance from 0.25 to 28.5 μm: Supplement LOWTRAN 3B (1976), AFGL-TR-76-0258, ERP 587.

interaction of radiation with solid particles always generates smoother spectral features than those resulting from gaseous absorption.

Throughout most of the visible and near infrared, it is the scattering coefficient due to aerosols which is most significant. At longer wavelengths, absorption by aerosols contributes significantly to the total extinction as well.

In general, it is necessary to know (or measure) two different quantities in order to describe adequately the aerosol extinction in the atmosphere: We must know the complex index of refraction of the particles; and we must know the particle size distribution (that is, the number of particles within a given size range for all particle sizes that might affect the extinction of radiation of the wavelength in question). A knowledge of these two quantities is sufficient if the assumption of spherical particles is valid. We also must know these two quantities as a function of position along the atmospheric path in question. Even if we can assume horizontal homogeneity, we must define the vertical variation of these quantities for anything other than a horizontal path. Given this information and assuming spherical particles, we can apply Mie theory calculations to the aerosol models and aerosol scattering and absorption coefficients can be computed.

The difficulty is that we usually do not have the necessary aerosol measurements available for the atmospheric path in question. In fact, generally, we don't have any kind of statistical base of aerosol measurements available for a given site. So, we need to develop some reasonable models based on all available measurements and then learn when these might be valid for an arbitrary atmospheric path.

Efforts have been made to do just this and much of the experimental data and analysis leading to such models can be examined in two reports by Shettle and Fenn.[12,13] A description of some of these models is also available in the LOWTRAN 3B report.

In the development of the LASER computer code, a subset of the aerosol models described in the three references has been used and will be described here. The extinction coefficients (scattering and absorption separately) used in the LASER program are given in Table 3 for each of the following models: Rural, Urban, Maritime, Tropospheric, Background Stratospheric, Aged Volcanic and Meteoric Dust. The first three of these models are intended to be strictly boundary layer models and may be applied only to the lowest 1 to 2 km. The third (Tropospheric) model may also be applied to the boundary layer under extremely clear continental conditions. The Background Stratospheric and Aged Volcanic provide a range of

12. Shettle, E.P., and Fenn, R.W. (1976) Models of the Atmospheric Aerosols and Their Optical Properties, AGARD Conference Proceedings No. 183, Optical Propagation in the Atmosphere, pp. 2.1-2.16.

13. Shettle, E.P., and Fenn, R.W. (1978) Models of the Atmospheric Aerosols and Their Optical Properties (to be published).

Table 3a. Attenuation Coefficients Resulting from Aerosol Extinction – Rural
(Normalized to an Extinction Coefficient = 1.00 $km^{-1}$ at a Wavelength = 0.55 $\mu M$)

| | | | |
|---|---|---|---|
| .200 | 2.419E+00 | 1.916E+00 | 5.829E-01 |
| .250 | 2.087E+00 | 1.656E+00 | 2.317E-01 |
| .300 | 1.806E+00 | 1.673E+00 | 1.335E-01 |
| .337 | 1.634E+00 | 1.537E+00 | 9.620E-02 |
| .400 | 1.394E+00 | 1.311E+00 | 8.337E-02 |
| .488 | 1.139E+00 | 1.068E+00 | 7.050E-02 |
| .515 | 1.076E+00 | 1.008E+00 | 6.748E-02 |
| .550 | 1.000E+00 | 9.387E-01 | 6.928E-02 |
| .633 | 8.516E-01 | 7.900E-01 | 6.159E-02 |
| .694 | 7.636E-01 | 7.023E-01 | 6.129E-02 |
| .860 | 5.792E-01 | 5.122E-01 | 6.694E-02 |
| 1.060 | 4.480E-01 | 3.802E-01 | 6.775E-02 |
| 1.300 | 3.322E-01 | 2.697E-01 | 6.247E-02 |
| 1.536 | 2.648E-01 | 2.057E-01 | 5.907E-02 |
| 1.800 | 1.978E-01 | 1.535E-01 | 4.432E-02 |
| 2.000 | 1.588E-01 | 1.312E-01 | 2.763E-02 |
| 2.250 | 1.429E-01 | 1.140E-01 | 2.894E-02 |
| 2.500 | 1.309E-01 | 1.016E-01 | 2.932E-02 |
| 2.700 | 1.439E-01 | 7.835E-02 | 6.559E-02 |
| 3.000 | 1.203E-01 | 8.330E-02 | 3.696E-02 |
| 3.200 | 1.139E-01 | 9.339E-02 | 2.046E-02 |
| 3.392 | 1.123E-01 | 9.251E-02 | 1.979E-02 |
| 3.500 | 1.118E-01 | 9.598E-02 | 1.583E-02 |
| 3.750 | 1.075E-01 | 9.394E-02 | 1.357E-02 |
| 4.000 | 1.047E-01 | 9.001E-02 | 1.465E-02 |
| 4.500 | 1.023E-01 | 8.011E-02 | 2.219E-02 |
| 5.000 | 9.705E-02 | 7.672E-02 | 2.033E-02 |
| 5.500 | 9.359E-02 | 6.904E-02 | 2.455E-02 |
| 6.000 | 8.791E-02 | 5.870E-02 | 2.921E-02 |
| 6.200 | 8.809E-02 | 5.696E-02 | 3.113E-02 |
| 6.500 | 8.842E-02 | 5.488E-02 | 3.354E-02 |
| 7.200 | 9.929E-02 | 5.216E-02 | 4.713E-02 |
| 7.900 | 6.978E-02 | 3.074E-02 | 3.904E-02 |
| 8.200 | 6.450E-02 | 1.340E-02 | 5.110E-02 |
| 8.500 | 1.126E-01 | 3.319E-02 | 7.937E-02 |
| 8.700 | 1.262E-01 | 5.497E-02 | 7.125E-02 |
| 9.000 | 1.337E-01 | 5.719E-02 | 7.649E-02 |
| 9.200 | 1.401E-01 | 5.289E-02 | 8.719E-02 |
| 9.500 | 1.184E-01 | 5.477E-02 | 6.358E-02 |
| 9.800 | 1.104E-01 | 5.774E-02 | 5.266E-02 |
| 10.000 | 1.085E-01 | 5.722E-02 | 5.123E-02 |
| 10.591 | 1.005E-01 | 5.749E-02 | 4.301E-02 |
| 11.000 | 9.579E-02 | 5.972E-02 | 3.607E-02 |
| 11.500 | 9.207E-02 | 5.823E-02 | 3.384E-02 |
| 12.500 | 8.639E-02 | 5.370E-02 | 3.269E-02 |
| 13.000 | 8.474E-02 | 5.164E-02 | 3.310E-02 |
| 14.000 | 8.140E-02 | 4.733E-02 | 3.407E-02 |
| 14.800 | 7.781E-02 | 3.926E-02 | 3.855E-02 |
| 15.000 | 8.654E-02 | 3.376E-02 | 5.278E-02 |
| 15.400 | 8.760E-02 | 4.353E-02 | 4.407E-02 |
| 17.200 | 9.369E-02 | 4.512E-02 | 4.857E-02 |
| 18.000 | 8.782E-02 | 4.495E-02 | 4.287E-02 |
| 18.500 | 8.562E-02 | 4.276E-02 | 4.286E-02 |
| 20.000 | 9.032E-02 | 4.175E-02 | 4.857E-02 |
| 21.300 | 8.947E-02 | 3.988E-02 | 4.959E-02 |
| 22.500 | 8.739E-02 | 3.683E-02 | 4.856E-02 |
| 25.000 | 8.242E-02 | 3.505E-02 | 4.737E-02 |
| 27.900 | 7.908E-02 | 3.095E-02 | 4.713E-02 |
| 30.000 | 7.624E-02 | 2.807E-02 | 4.817E-02 |
| 35.000 | 7.486E-02 | 2.601E-02 | 4.885E-02 |
| 40.000 | 7.283E-02 | 2.311E-02 | 4.972E-02 |

Table 3b. Attenuation Coefficients Resulting from Aerosol Extinction – Urban
(Normalized to an Extinction Coefficient = 1.00 $km^{-1}$ at a Wavelength = 0.55 $\mu m$)

| | | | |
|---|---|---|---|
| .200 | 1.364E+00 | 1.287E+00 | 6.767E-01 |
| .250 | 1.798E+00 | 1.251E+00 | 5.474E-01 |
| .300 | 1.633E+00 | 1.154E+00 | 4.792E-01 |
| .337 | 1.507E+00 | 1.065E+00 | 4.417E-01 |
| .400 | 1.321E+00 | 9.171E-01 | 4.036E-01 |
| .488 | 1.116E+00 | 7.567E-01 | 3.591E-01 |
| .515 | 1.065E+00 | 7.167E-01 | 3.482E-01 |
| .550 | 1.000E+00 | 6.657E-01 | 3.343E-01 |
| .633 | 8.732E-01 | 5.706E-01 | 3.027E-01 |
| .694 | 7.976E-01 | 5.110E-01 | 2.866E-01 |
| .860 | 6.374E-01 | 3.828E-01 | 2.545E-01 |
| 1.060 | 5.152E-01 | 2.896E-01 | 2.256E-01 |
| 1.300 | 4.095E-01 | 2.131E-01 | 1.964E-01 |
| 1.536 | 3.423E-01 | 1.670E-01 | 1.753E-01 |
| 1.800 | 2.926E-01 | 1.302E-01 | 1.524E-01 |
| 2.000 | 2.468E-01 | 1.129E-01 | 1.339E-01 |
| 2.250 | 2.224E-01 | 9.833E-02 | 1.240E-01 |
| 2.500 | 2.032E-01 | 8.758E-02 | 1.157E-01 |
| 2.700 | 2.016E-01 | 7.286E-02 | 1.288E-01 |
| 3.000 | 1.796E-01 | 7.209E-02 | 1.075E-01 |
| 3.200 | 1.692E-01 | 7.572E-02 | 9.346E-02 |
| 3.392 | 1.635E-01 | 7.383E-02 | 8.966E-02 |
| 3.500 | 1.611E-01 | 7.500E-02 | 8.610E-02 |
| 3.750 | 1.532E-01 | 7.258E-02 | 8.063E-02 |
| 4.000 | 1.468E-01 | 6.939E-02 | 7.739E-02 |
| 4.500 | 1.369E-01 | 6.220E-02 | 7.474E-02 |
| 5.000 | 1.272E-01 | 5.900E-02 | 6.824E-02 |
| 5.500 | 1.200E-01 | 5.386E-02 | 6.613E-02 |
| 6.000 | 1.124E-01 | 4.767E-02 | 6.472E-02 |
| 6.200 | 1.113E-01 | 4.634E-02 | 6.492E-02 |
| 6.500 | 1.089E-01 | 4.496E-02 | 6.393E-02 |
| 7.200 | 1.106E-01 | 4.271E-02 | 6.784E-02 |
| 7.900 | 9.148E-02 | 3.118E-02 | 6.030E-02 |
| 8.200 | 8.759E-02 | 2.199E-02 | 6.560E-02 |
| 8.500 | 1.112E-01 | 3.205E-02 | 7.916E-02 |
| 8.700 | 1.173E-01 | 4.318E-02 | 7.416E-02 |
| 9.000 | 1.202E-01 | 4.414E-02 | 7.610E-02 |
| 9.200 | 1.227E-01 | 4.181E-02 | 8.090E-02 |
| 9.500 | 1.106E-01 | 4.262E-02 | 6.802E-02 |
| 9.800 | 1.056E-01 | 4.400E-02 | 6.161E-02 |
| 10.000 | 1.040E-01 | 4.365E-02 | 6.037E-02 |
| 10.591 | 9.843E-02 | 4.350E-02 | 5.493E-02 |
| 11.000 | 9.488E-02 | 4.448E-02 | 5.040E-02 |
| 11.500 | 9.192E-02 | 4.350E-02 | 4.842E-02 |
| 12.500 | 8.687E-02 | 4.083E-02 | 4.604E-02 |
| 13.000 | 8.523E-02 | 3.961E-02 | 4.562E-02 |
| 14.000 | 8.189E-02 | 3.713E-02 | 4.476E-02 |
| 14.800 | 7.896E-02 | 3.275E-02 | 4.621E-02 |
| 15.000 | 8.321E-02 | 2.985E-02 | 5.336E-02 |
| 16.400 | 8.208E-02 | 3.457E-02 | 4.751E-02 |
| 17.200 | 8.435E-02 | 3.524E-02 | 4.911E-02 |
| 18.000 | 8.094E-02 | 3.499E-02 | 4.595E-02 |
| 18.500 | 7.881E-02 | 3.376E-02 | 4.505E-02 |
| 20.000 | 7.989E-02 | 3.298E-02 | 4.691E-02 |
| 21.300 | 7.846E-02 | 3.174E-02 | 4.672E-02 |
| 22.500 | 7.651E-02 | 3.099E-02 | 4.552E-02 |
| 25.000 | 7.235E-02 | 2.861E-02 | 4.374E-02 |
| 27.900 | 6.847E-02 | 2.601E-02 | 4.246E-02 |
| 30.000 | 6.648E-02 | 2.422E-02 | 4.226E-02 |
| 35.000 | 6.360E-02 | 2.248E-02 | 4.112E-02 |
| 40.000 | 6.065E-02 | 2.037E-02 | 4.028E-02 |

Table 3c. Attenuation Coefficients Resulting from Aerosol Extinction – Maritime
(Normalized to an Extinction Coefficient = 1.00 $km^{-1}$ at a Wavelength = 0.55 $\mu m$)

| | | | |
|---|---|---|---|
| .200 | 1.318E+00 | 1.184E+00 | 1.300E-01 |
| .250 | 1.235E+00 | 1.181E+00 | 5.471E-02 |
| .300 | 1.170E+00 | 1.142E+00 | 2.800E-02 |
| .337 | 1.134E+00 | 1.115E+00 | 1.858E-02 |
| .400 | 1.078E+00 | 1.063E+00 | 1.536E-02 |
| .488 | 1.026E+00 | 1.014E+00 | 1.221E-02 |
| .515 | 1.009E+00 | 9.975E-01 | 1.147E-02 |
| .550 | 1.000E+00 | 9.882E-01 | 1.179E-02 |
| .633 | 9.655E-01 | 9.556E-01 | 9.960E-03 |
| .694 | 9.494E-01 | 9.396E-01 | 9.790E-03 |
| .860 | 9.121E-01 | 9.013E-01 | 1.084E-02 |
| 1.060 | 8.803E-01 | 8.682E-01 | 1.210E-02 |
| 1.360 | 8.406E-01 | 8.288E-01 | 1.178E-02 |
| 1.536 | 8.071E-01 | 7.951E-01 | 1.207E-02 |
| 1.800 | 7.626E-01 | 7.534E-01 | 9.180E-03 |
| 2.000 | 7.297E-01 | 7.159E-01 | 1.380E-02 |
| 2.250 | 6.878E-01 | 6.772E-01 | 1.062E-02 |
| 2.500 | 6.305E-01 | 6.093E-01 | 2.125E-02 |
| 2.700 | 5.713E-01 | 4.399E-01 | 9.134E-02 |
| 3.000 | 6.599E-01 | 3.271E-01 | 3.328E-01 |
| 3.200 | 6.902E-01 | 4.594E-01 | 2.208E-01 |
| 3.392 | 6.471E-01 | 5.670E-01 | 8.004E-02 |
| 3.500 | 6.265E-01 | 5.849E-01 | 4.164E-02 |
| 3.750 | 5.917E-01 | 5.645E-01 | 1.718E-02 |
| 4.000 | 5.487E-01 | 5.289E-01 | 1.985E-02 |
| 4.500 | 4.945E-01 | 4.520E-01 | 4.247E-02 |
| 5.000 | 4.438E-01 | 4.072E-01 | 3.660E-02 |
| 5.500 | 3.752E-01 | 3.431E-01 | 3.207E-02 |
| 6.000 | 3.471E-01 | 1.984E-01 | 1.488E-01 |
| 6.200 | 4.334E-01 | 2.886E-01 | 1.448E-01 |
| 6.500 | 3.618E-01 | 2.879E-01 | 7.387E-02 |
| 7.200 | 3.011E-01 | 2.415E-01 | 5.965E-02 |
| 7.900 | 2.572E-01 | 1.988E-01 | 5.840E-02 |
| 8.200 | 2.506E-01 | 1.869E-01 | 6.368E-02 |
| 8.500 | 2.560E-01 | 1.848E-01 | 7.119E-02 |
| 8.700 | 2.701E-01 | 1.996E-01 | 7.051E-02 |
| 9.000 | 2.663E-01 | 1.955E-01 | 7.085E-02 |
| 9.200 | 2.507E-01 | 1.786E-01 | 7.218E-02 |
| 9.500 | 2.248E-01 | 1.609E-01 | 6.397E-02 |
| 9.800 | 2.061E-01 | 1.439E-01 | 6.222E-02 |
| 10.000 | 1.931E-01 | 1.307E-01 | 6.245E-02 |
| 10.591 | 1.634E-01 | 9.447E-02 | 6.893E-02 |
| 11.000 | 1.563E-01 | 7.216E-02 | 8.415E-02 |
| 11.500 | 1.618E-01 | 5.652E-02 | 1.052E-01 |
| 12.500 | 1.952E-01 | 4.523E-02 | 1.490E-01 |
| 13.000 | 2.114E-01 | 4.841E-02 | 1.629E-01 |
| 14.000 | 2.334E-01 | 5.448E-02 | 1.789E-01 |
| 14.800 | 2.412E-01 | 5.801E-02 | 1.832E-01 |
| 15.000 | 2.461E-01 | 5.950E-02 | 1.866E-01 |
| 16.400 | 2.545E-01 | 6.689E-02 | 1.876E-01 |
| 17.200 | 2.608E-01 | 7.504E-02 | 1.858E-01 |
| 18.000 | 2.556E-01 | 7.611E-02 | 1.795E-01 |
| 18.500 | 2.501E-01 | 7.484E-02 | 1.752E-01 |
| 20.000 | 2.309E-01 | 7.033E-02 | 1.606E-01 |
| 21.300 | 2.160E-01 | 6.514E-02 | 1.509E-01 |
| 22.500 | 2.045E-01 | 6.128E-02 | 1.433E-01 |
| 25.000 | 1.836E-01 | 5.367E-02 | 1.299E-01 |
| 27.900 | 1.659E-01 | 4.611E-02 | 1.198E-01 |
| 30.000 | 1.532E-01 | 4.085E-02 | 1.123E-01 |
| 35.000 | 1.419E-01 | 3.806E-02 | 1.119E-01 |
| 40.000 | 1.590E-01 | 2.533E-02 | 1.336E-01 |

Table 3d. Attenuation Coefficients Resulting from Aerosol Extinction—Tropospheric (Normalized to an Extinction Coefficient = 1.00 $km^{-1}$ at a Wavelength = 0.55 μm)

| | | | |
|---|---|---|---|
| .200 | 2.545E+00 | 2.036E+00 | 5.090E-01 |
| .250 | 2.184E+00 | 1.966E+00 | 2.184E-01 |
| .300 | 1.878E+00 | 1.766E+00 | 1.119E-01 |
| .337 | 1.690E+00 | 1.616E+00 | 7.429E-02 |
| .400 | 1.429E+00 | 1.368E+00 | 6.144E-02 |
| .488 | 1.151E+00 | 1.102E+00 | 4.884E-02 |
| .515 | 1.082E+00 | 1.037E+00 | 4.589E-02 |
| .550 | 1.000E+00 | 9.528E-01 | 4.716E-02 |
| .633 | 8.381E-01 | 7.983E-01 | 3.985E-02 |
| .694 | 7.419E-01 | 7.028E-01 | 3.916E-02 |
| .860 | 5.403E-01 | 4.971E-01 | 4.326E-02 |
| 1.060 | 3.965E-01 | 3.532E-01 | 4.336E-02 |
| 1.300 | 2.693E-01 | 2.313E-01 | 3.796E-02 |
| 1.536 | 1.948E-01 | 1.603E-01 | 3.451E-02 |
| 1.800 | 1.210E-01 | 9.904E-02 | 2.200E-02 |
| 2.000 | 7.853E-02 | 6.761E-02 | 1.092E-02 |
| 2.250 | 6.151E-02 | 5.005E-02 | 1.146E-02 |
| 2.500 | 4.954E-02 | 3.797E-02 | 1.157E-02 |
| 2.700 | 6.541E-02 | 2.650E-02 | 3.891E-02 |
| 3.000 | 3.983E-02 | 2.394E-02 | 1.589E-02 |
| 3.200 | 3.027E-02 | 2.350E-02 | 6.770E-03 |
| 3.392 | 2.781E-02 | 2.133E-02 | 6.480E-03 |
| 3.500 | 2.657E-02 | 2.174E-02 | 4.830E-03 |
| 3.750 | 2.240E-02 | 1.838E-02 | 4.020E-03 |
| 4.000 | 1.998E-02 | 1.564E-02 | 4.340E-03 |
| 4.500 | 1.860E-02 | 1.159E-02 | 7.010E-03 |
| 5.000 | 1.472E-02 | 8.490E-03 | 6.230E-03 |
| 5.500 | 1.416E-02 | 6.110E-03 | 8.050E-03 |
| 6.000 | 1.481E-02 | 4.010E-03 | 1.080E-02 |
| 6.200 | 1.562E-02 | 3.930E-03 | 1.169E-02 |
| 6.500 | 1.659E-02 | 3.830E-03 | 1.276E-02 |
| 7.200 | 2.330E-02 | 2.940E-03 | 2.036E-02 |
| 7.900 | 1.856E-02 | 5.500E-04 | 1.801E-02 |
| 8.200 | 2.946E-02 | 1.700E-04 | 2.929E-02 |
| 8.500 | 4.168E-02 | 1.210E-03 | 4.047E-02 |
| 8.700 | 4.204E-02 | 7.850E-03 | 3.419E-02 |
| 9.000 | 4.597E-02 | 8.470E-03 | 3.750E-02 |
| 9.200 | 5.432E-02 | 6.200E-03 | 4.812E-02 |
| 9.500 | 3.184E-02 | 4.840E-03 | 2.700E-02 |
| 9.800 | 2.389E-02 | 4.230E-03 | 1.966E-02 |
| 10.000 | 2.270E-02 | 3.750E-03 | 1.895E-02 |
| 10.591 | 1.720E-02 | 2.750E-03 | 1.445E-02 |
| 11.000 | 1.343E-02 | 2.350E-03 | 1.108E-02 |
| 11.500 | 1.212E-02 | 1.950E-03 | 1.027E-02 |
| 12.500 | 1.110E-02 | 1.220E-03 | 9.970E-03 |
| 13.000 | 1.140E-02 | 1.040E-03 | 1.036E-02 |
| 14.000 | 1.151E-02 | 7.500E-04 | 1.076E-02 |
| 14.800 | 1.438E-02 | 4.900E-04 | 1.389E-02 |
| 15.000 | 2.420E-02 | 4.600E-04 | 2.374E-02 |
| 16.400 | 1.556E-02 | 6.900E-04 | 1.488E-02 |
| 17.200 | 1.670E-02 | 9.200E-04 | 1.578E-02 |
| 18.000 | 1.396E-02 | 7.200E-04 | 1.324E-02 |
| 18.500 | 1.401E-02 | 5.600E-04 | 1.345E-02 |
| 20.000 | 1.591E-02 | 5.100E-04 | 1.530E-02 |
| 21.300 | 1.665E-02 | 4.900E-04 | 1.616E-02 |
| 22.500 | 1.593E-02 | 4.000E-04 | 1.553E-02 |
| 25.000 | 1.581E-02 | 2.600E-04 | 1.555E-02 |
| 27.900 | 1.625E-02 | 1.700E-04 | 1.608E-02 |
| 30.000 | 1.744E-02 | 1.200E-04 | 1.732E-02 |
| 35.000 | 1.739E-02 | 9.000E-05 | 1.730E-02 |
| 40.000 | 1. 13E-02 | 6.000E-05 | 1.907E-02 |

Table 3e. Attenuation Coefficients Resulting from Aerosol Extinction - Background Stratospheric (Normalized to an Extinction Coefficient = 1.00 $km^{-1}$ at a Wavelength = 0.55 μm)

| | | | |
|---|---|---|---|
| .200 | 1.487E+00 | 1.487E+00 | 0. |
| .250 | 1.553E+00 | 1.553E+00 | 0. |
| .300 | 1.555E+00 | 1.555E+00 | 0. |
| .337 | 1.515E+00 | 1.515E+00 | 0. |
| .400 | 1.376E+00 | 1.376E+00 | 0. |
| .488 | 1.150E+00 | 1.150E+00 | 0. |
| .515 | 1.087E+00 | 1.087E+00 | 0. |
| .550 | 1.000E+00 | 1.000E+00 | 0. |
| .633 | 8.224E-01 | 8.224E-01 | 0. |
| .694 | 7.063E-01 | 7.063E-01 | 0. |
| .860 | 4.685E-01 | 4.685E-01 | 0. |
| 1.060 | 2.886E-01 | 2.886E-01 | 0. |
| 1.300 | 1.642E-01 | 1.642E-01 | 2.000E-05 |
| 1.536 | 9.992E-02 | 9.972E-02 | 2.000E-04 |
| 1.800 | 5.881E-02 | 5.817E-02 | 6.400E-04 |
| 2.000 | 4.183E-02 | 4.055E-02 | 1.280E-03 |
| 2.250 | 2.727E-02 | 2.570E-02 | 1.570E-03 |
| 2.500 | 1.849E-02 | 1.560E-02 | 2.890E-03 |
| 2.700 | 1.334E-02 | 9.310E-03 | 4.030E-03 |
| 3.000 | 6.510E-02 | 6.320E-03 | 5.878E-02 |
| 3.200 | 8.271E-02 | 6.000E-03 | 7.671E-02 |
| 3.392 | 8.927E-02 | 6.270E-03 | 8.300E-02 |
| 3.500 | 8.540E-02 | 6.230E-03 | 7.917E-02 |
| 3.750 | 6.529E-02 | 5.100E-03 | 6.019E-02 |
| 4.000 | 5.794E-02 | 4.030E-03 | 5.391E-02 |
| 4.500 | 4.764E-02 | 2.420E-03 | 4.522E-02 |
| 5.000 | 4.277E-02 | 1.450E-03 | 4.132E-02 |
| 5.500 | 5.807E-02 | 1.030E-03 | 5.704E-02 |
| 6.000 | 5.368E-02 | 1.050E-03 | 5.263E-02 |
| 6.200 | 4.392E-02 | 8.800E-04 | 4.304E-02 |
| 6.500 | 3.338E-02 | 5.500E-04 | 3.283E-02 |
| 7.200 | 4.456E-02 | 1.900E-04 | 4.437E-02 |
| 7.900 | 1.187E-01 | 5.000E-04 | 1.182E-01 |
| 8.200 | 1.471E-01 | 7.700E-04 | 1.463E-01 |
| 8.500 | 1.457E-01 | 9.500E-04 | 1.448E-01 |
| 8.700 | 1.274E-01 | 9.600E-04 | 1.264E-01 |
| 9.000 | 9.289E-02 | 7.200E-04 | 9.217E-02 |
| 9.200 | 8.780E-02 | 5.800E-04 | 8.722E-02 |
| 9.500 | 1.006E-01 | 7.100E-04 | 9.987E-02 |
| 9.800 | 7.323E-02 | 6.700E-04 | 7.256E-02 |
| 10.000 | 5.020E-02 | 4.900E-04 | 4.971E-02 |
| 10.591 | 4.068E-02 | 2.700E-04 | 4.041E-02 |
| 11.000 | 5.736E-02 | 2.600E-04 | 5.710E-02 |
| 11.500 | 3.575E-02 | 2.600E-04 | 3.549E-02 |
| 12.500 | 1.975E-02 | 1.300E-04 | 1.962E-02 |
| 13.000 | 1.940E-02 | 1.000E-04 | 1.930E-02 |
| 14.000 | 1.867E-02 | 7.000E-05 | 1.860E-02 |
| 14.800 | 1.895E-02 | 5.000E-05 | 1.890E-02 |
| 15.000 | 1.953E-02 | 5.000E-05 | 1.948E-02 |
| 16.400 | 3.665E-02 | 4.000E-05 | 3.661E-02 |
| 17.200 | 4.152E-02 | 5.000E-05 | 4.147E-02 |
| 18.000 | 2.326E-02 | 5.000E-05 | 2.321E-02 |
| 18.500 | 1.714E-02 | 4.000E-05 | 1.710E-02 |
| 20.000 | 1.345E-02 | 2.000E-05 | 1.343E-02 |
| 21.300 | 1.619E-02 | 2.000E-05 | 1.617E-02 |
| 22.500 | 1.532E-02 | 2.000E-05 | 1.530E-02 |
| 25.000 | 8.370E-03 | 1.000E-05 | 8.360E-03 |
| 27.900 | 6.810E-03 | 1.000E-05 | 6.800E-03 |
| 30.000 | 6.330E-03 | 1.000E-05 | 6.320E-03 |
| 35.000 | 5.800E-03 | 0. | 5.800E-03 |
| 40.000 | 5.920E-03 | 0. | 5.920E-03 |

Table 3f. Attenuation Coefficients Resulting from Aerosol Extinction – Aged Volcanic (Normalized to an Extinction Coefficient = 1.00 $km^{-1}$ at a Wavelength = 0.55 $\mu m$)

| | | | |
|---|---|---|---|
| .200 | 1.149E+00 | 7.006E-01 | 4.482E-01 |
| .250 | 1.183E+00 | 9.009E-01 | 2.818E-01 |
| .300 | 1.192E+00 | 1.079E+00 | 1.126E-01 |
| .337 | 1.180E+00 | 1.095E+00 | 8.497E-02 |
| .400 | 1.140E+00 | 1.068E+00 | 7.244E-02 |
| .488 | 1.063E+00 | 1.003E+00 | 5.962E-02 |
| .515 | 1.036E+00 | 9.799E-01 | 5.651E-02 |
| .550 | 1.000E+00 | 9.473E-01 | 5.271E-02 |
| .633 | 9.129E-01 | 8.676E-01 | 4.532E-02 |
| .694 | 8.487E-01 | 8.079E-01 | 4.084E-02 |
| .860 | 6.987E-01 | 6.570E-01 | 3.178E-02 |
| 1.060 | 5.302E-01 | 5.057E-01 | 2.452E-02 |
| 1.300 | 3.881E-01 | 3.693E-01 | 1.881E-02 |
| 1.536 | 2.797E-01 | 2.640E-01 | 1.490E-02 |
| 1.800 | 1.968E-01 | 1.849E-01 | 1.191E-02 |
| 2.000 | 1.455E-01 | 1.353E-01 | 1.019E-02 |
| 2.250 | 1.107E-01 | 1.021E-01 | 8.670E-03 |
| 2.500 | 8.635E-02 | 7.792E-02 | 8.430E-03 |
| 2.700 | 7.185E-02 | 6.343E-02 | 8.420E-03 |
| 3.000 | 6.075E-02 | 5.126E-02 | 9.490E-03 |
| 3.200 | 5.198E-02 | 4.262E-02 | 9.360E-03 |
| 3.392 | 4.504E-02 | 3.761E-02 | 7.430E-03 |
| 3.500 | 4.089E-02 | 3.435E-02 | 6.540E-03 |
| 3.750 | 3.401E-02 | 2.913E-02 | 4.880E-03 |
| 4.000 | 2.743E-02 | 2.394E-02 | 3.490E-03 |
| 4.500 | 2.094E-02 | 1.775E-02 | 3.190E-03 |
| 5.000 | 1.539E-02 | 1.204E-02 | 3.350E-03 |
| 5.500 | 1.265E-02 | 8.690E-03 | 3.960E-03 |
| 6.000 | 1.021E-02 | 5.700E-03 | 4.510E-03 |
| 6.200 | 9.920E-03 | 4.670E-03 | 5.250E-03 |
| 6.500 | 1.043E-02 | 3.780E-03 | 6.650E-03 |
| 7.200 | 1.362E-02 | 2.500E-03 | 1.112E-02 |
| 7.900 | 1.788E-02 | 1.360E-03 | 1.652E-02 |
| 8.200 | 2.279E-02 | 9.900E-04 | 2.180E-02 |
| 8.500 | 2.475E-02 | 2.570E-03 | 2.218E-02 |
| 8.700 | 2.919E-02 | 4.810E-03 | 2.438E-02 |
| 9.000 | 3.100E-02 | 6.020E-03 | 2.506E-02 |
| 9.200 | 3.231E-02 | 5.730E-03 | 2.658E-02 |
| 9.500 | 3.389E-02 | 5.180E-03 | 2.871E-02 |
| 9.800 | 3.454E-02 | 4.750E-03 | 2.979E-02 |
| 10.000 | 3.458E-02 | 4.490E-03 | 3.009E-02 |
| 10.591 | 3.181E-02 | 3.220E-03 | 2.859E-02 |
| 11.000 | 2.771E-02 | 2.600E-03 | 2.511E-02 |
| 11.500 | 2.473E-02 | 1.910E-03 | 2.282E-02 |
| 12.500 | 1.713E-02 | 9.000E-04 | 1.623E-02 |
| 13.000 | 1.601E-02 | 7.100E-04 | 1.530E-02 |
| 14.000 | 1.493E-02 | 4.600E-04 | 1.447E-02 |
| 14.860 | 1.565E-02 | 3.300E-04 | 1.532E-02 |
| 15.000 | 1.667E-02 | 3.200E-04 | 1.635E-02 |
| 16.400 | 1.648E-02 | 2.800E-04 | 1.620E-02 |
| 17.200 | 1.735E-02 | 2.900E-04 | 1.706E-02 |
| 18.000 | 1.857E-02 | 3.100E-04 | 1.826E-02 |
| 18.500 | 1.772E-02 | 3.100E-04 | 1.741E-02 |
| 20.000 | 1.416E-02 | 2.600E-04 | 1.390E-02 |
| 21.300 | 1.077E-02 | 2.300E-04 | 1.054E-02 |
| 22.500 | 1.124E-02 | 2.000E-04 | 1.104E-02 |
| 25.000 | 1.052E-02 | 1.400E-04 | 1.038E-02 |
| 27.900 | 1.080E-02 | 8.000E-05 | 1.072E-02 |
| 30.000 | 1.130E-02 | 6.000E-05 | 1.124E-02 |
| 35.000 | 1.195E-02 | 3.000E-05 | 1.192E-02 |
| 40.000 | 1.330E-02 | 2.000E-05 | 1.328E-02 |

Table 3g. Attenuation Coefficients Resulting from Aerosol Extinction – Meteoric Dust (Normalized to an Extinction Coefficient = 1.00 $km^{-1}$ at a Wavelength = 0.55 μm)

| | | | |
|---|---|---|---|
| .200 | 1.050E+00 | 1.050E+00 | 6.300E-04 |
| .250 | 1.058E+00 | 1.057E+00 | 9.900E-04 |
| .300 | 1.059E+00 | 1.057E+00 | 1.520E-03 |
| .337 | 1.053E+00 | 1.051E+00 | 1.810E-03 |
| .400 | 1.043E+00 | 1.041E+00 | 2.600E-03 |
| .488 | 1.020E+00 | 1.016E+00 | 3.870E-03 |
| .515 | 1.012E+00 | 1.007E+00 | 4.310E-03 |
| .550 | 1.000E+00 | 9.949E-01 | 5.060E-03 |
| .633 | 9.723E-01 | 9.657E-01 | 6.640E-03 |
| .694 | 9.495E-01 | 9.416E-01 | 7.930E-03 |
| .860 | 8.877E-01 | 8.756E-01 | 1.212E-02 |
| 1.060 | 8.146E-01 | 7.963E-01 | 1.827E-02 |
| 1.300 | 7.329E-01 | 7.057E-01 | 2.716E-02 |
| 1.536 | 6.605E-01 | 6.233E-01 | 3.725E-02 |
| 1.800 | 5.889E-01 | 5.390E-01 | 4.998E-02 |
| 2.000 | 5.436E-01 | 4.822E-01 | 6.161E-02 |
| 2.250 | 4.914E-01 | 4.160E-01 | 7.539E-02 |
| 2.500 | 4.468E-01 | 3.574E-01 | 8.943E-02 |
| 2.700 | 4.167E-01 | 3.162E-01 | 1.005E-01 |
| 3.000 | 3.806E-01 | 2.645E-01 | 1.161E-01 |
| 3.200 | 3.621E-01 | 2.367E-01 | 1.254E-01 |
| 3.392 | 3.478E-01 | 2.147E-01 | 1.331E-01 |
| 3.500 | 3.410E-01 | 2.042E-01 | 1.368E-01 |
| 3.750 | 3.280E-01 | 1.845E-01 | 1.435E-01 |
| 4.000 | 3.172E-01 | 1.700E-01 | 1.472E-01 |
| 4.500 | 2.972E-01 | 1.509E-01 | 1.463E-01 |
| 5.000 | 2.751E-01 | 1.378E-01 | 1.373E-01 |
| 5.500 | 2.508E-01 | 1.262E-01 | 1.246E-01 |
| 6.000 | 2.262E-01 | 1.144E-01 | 1.118E-01 |
| 6.200 | 2.166E-01 | 1.094E-01 | 1.071E-01 |
| 6.500 | 2.025E-01 | 1.018E-01 | 1.008E-01 |
| 7.200 | 1.727E-01 | 8.264E-02 | 9.004E-02 |
| 7.900 | 1.491E-01 | 6.170E-02 | 8.737E-02 |
| 8.200 | 1.424E-01 | 5.237E-02 | 8.999E-02 |
| 8.500 | 1.394E-01 | 4.326E-02 | 9.618E-02 |
| 8.700 | 1.408E-01 | 3.775E-02 | 1.031E-01 |
| 9.000 | 1.506E-01 | 3.151E-02 | 1.191E-01 |
| 9.200 | 1.640E-01 | 2.962E-02 | 1.344E-01 |
| 9.500 | 1.944E-01 | 3.129E-02 | 1.631E-01 |
| 9.800 | 2.252E-01 | 3.697E-02 | 1.882E-01 |
| 10.000 | 2.361E-01 | 4.059E-02 | 1.955E-01 |
| 10.591 | 2.448E-01 | 4.385E-02 | 2.010E-01 |
| 11.000 | 2.779E-01 | 5.296E-02 | 2.250E-01 |
| 11.500 | 2.507E-01 | 6.657E-02 | 1.842E-01 |
| 12.500 | 1.527E-01 | 5.990E-02 | 9.282E-02 |
| 13.000 | 1.316E-01 | 5.084E-02 | 8.076E-02 |
| 14.000 | 1.144E-01 | 3.968E-02 | 7.476E-02 |
| 14.800 | 9.603E-02 | 2.937E-02 | 6.666E-02 |
| 15.000 | 9.456E-02 | 2.633E-02 | 6.823E-02 |
| 16.400 | 1.458E-01 | 2.245E-02 | 1.233E-01 |
| 17.200 | 1.237E-01 | 1.822E-02 | 1.055E-01 |
| 18.000 | 1.560E-01 | 1.767E-02 | 1.383E-01 |
| 18.500 | 1.835E-01 | 2.167E-02 | 1.618E-01 |
| 20.000 | 1.604E-01 | 2.886E-02 | 1.315E-01 |
| 21.300 | 1.219E-01 | 2.356E-02 | 9.836E-02 |
| 22.500 | 1.227E-01 | 1.84?E-02 | 1.043E-01 |
| 25.000 | 1.292E-01 | 2.339E-02 | 1.058E-01 |
| 27.900 | 9.600E-02 | 1.851E-02 | 7.749E-02 |
| 30.000 | 8.541E-02 | 1.783E-02 | 6.758E-02 |
| 35.000 | 5.055E-02 | 1.360E-02 | 3.695E-02 |
| 40.000 | 4.109E-02 | 8.640E-03 | 3.245E-02 |

extinction for the stratosphere. Currently, conditions are similar to the Background Stratospheric, although the eruption of new major volcanos could change this. The volcanic stratospheric model should be used to represent the stratosphere during the late 1960's and early 1970's. The meteoric dust model is intended to be used only above 30 km.

The question of when to apply the three boundary layer models remains somewhat ambiguous and requires some judgment. Some rules-of-thumb follow: (1) Relatively clear, continental air having a trajectory from relatively unpolluted land areas should usually be represented by the Rural model. (2) The Urban model should be used not only in urban areas under rather stagnant, stable weather conditions, but may also be used in regions where the trajectory of the prevailing air mass indicates an urban origin. (3) The Maritime model should be used not only over the oceans, but also over land areas where the trajectory is obviously maritime.

The LASER program has been set up using the Rural model in the lowest 2 km, but results for a sea-level path are also provided for any input laser wavelength for the Urban, Maritime, and Tropospheric models.

Table 4 has been constructed based on extinction coefficient and number density measurements of aerosols as a function of altitude. This table constitutes a series of scaling factors which, when multiplied by the scattering and absorption coefficients of Table 3, give the scattering and absorption coefficients as a function of altitude. The work of Shettle and Fenn[12, 13] provide many more models than could be accommodated in the LASER code, so here we have limited these to a "Clear" and a "Hazy" model which at sea level relates to a meteorological range of 50 km and 5 km, respectively. Aside from the options available for the boundary layer, the LASER program divides the atmosphere in the vertical into four general regions and uses the extinction coefficients in the "Clear" and "Hazy" atmospheric aerosol models as indicated in Table 4. If the extinction coefficient for other than 50- or 5-km meteorological range is required, a linear interpolation will provide a reasonable estimate.

Table 4. Scaling Factors Representing Vertical Distributions of Aerosol Extinction

| Height | Clear | Hazy | |
|---|---|---|---|
| 0.0 | 6.95E-2 | 7.57E-1 | Uses Rural Extinction Coefficients |
| 1.0 | 2.58E-2 | 7.57E-1 | |
| 2.0 | 9.70E-3 | 6.21E-2 | |
| 3.0 | 8.19E-3 | 3.46E-2 | |
| 4.0 | 6.43E-3 | 1.85E-2 | |
| 5.0 | 4.85E-3 | 9.30E-3 | Uses Tropospheric Extinction Coefficients |
| 6.0 | 3.54E-3 | 7.71E-3 | |
| 7.0 | 2.30E-3 | 6.22E-3 | |
| 8.0 | 1.41E-3 | 3.36E-3 | |
| 9.0 | 9.80E-4 | 1.81E-3 | |
| 10.0 | 7.87E-4 | 1.85E-3 | |
| 11.0 | 7.14E-4 | 2.11E-3 | |
| 12.0 | 6.63E-4 | 2.45E-3 | |
| 13.0 | 6.22E-4 | 2.80E-3 | |
| 14.0 | 6.45E-4 | 2.89E-3 | Uses Background Stratospheric Extinction Coefficients for "CLEAR" and Aged Volcanic Extinction Coefficients for "HAZY" |
| 15.0 | 6.43E-4 | 2.92E-3 | |
| 16.0 | 6.41E-4 | 2.74E-3 | |
| 17.0 | 6.01E-4 | 2.46E-3 | |
| 18.0 | 5.63E-4 | 2.10E-3 | |
| 19.0 | 4.92E-4 | 1.71E-3 | |
| 20.0 | 4.23E-4 | 1.35E-3 | |
| 21.0 | 3.52E-4 | 1.09E-3 | |
| 22.0 | 2.96E-4 | 8.60E-4 | |
| 23.0 | 2.42E-4 | 6.60E-4 | |
| 24.0 | 1.90E-4 | 5.15E-4 | |
| 25.0 | 1.50E-4 | 4.10E-4 | |
| 30.0 | 3.32E-5 | 7.60E-5 | |
| 35.0 | 1.65E-5 | 2.45E-5 | |
| 40.0 | 8.00E-6 | 8.00E-6 | |
| 45.0 | 4.02E-6 | 4.02E-6 | Uses Meteoric Dust Extinction Coefficients |
| 50.0 | 2.10E-6 | 2.10E-6 | |
| 70.0 | 1.60E-7 | 1.60E-7 | |
| 100.0 | 9.30E-10 | 9.30E-10 | |

## 4. ATMOSPHERIC MODELS

The atmospheric models used in the LASER computer code have been described by McClatchey et al[14] and the six standard models of temperature, pressure, water vapor and ozone distributions as a function of height are included here in Table 6. A number of additional gases of importance to the computation of molecular absorption have been assumed to be uniformly mixed by volume in the atmosphere at the concentrations given in Table 5. If the user of the LASER computer code is interested in performing an extinction coefficient calculation for an atmospheric model differing from the six models provided as input, he may simply substitute an alternative set of input data for any one of the models, being careful to use the same units for all quantities. The aerosol models have been described in Section 3 and the reader is referred to References 12 and 13 for a more thorough discussion.

Table 5. Concentrations of Uniformly Mixed Gases

| Constituent | Concentration (ppm V) |
|---|---|
| $CO_2$ | 330 |
| $N_2O$ | 0.28 |
| CO | 0.075 |
| $CH_4$ | 1.6 |
| $O_2$ | $2.095 \times 10^5$ |
| $N_2$ | $7.808 \times 10^5$ |

14. McClatchey, R.A., Fenn, R.W., Selby, J.E.A., Volz, F.E., and Garing, J.S. (1972) Optical Properties of the Atmosphere (Third Edition), AFCRL-72-0497, ERP No. 411.

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties

| TROPICAL | | | | | |
|---|---|---|---|---|---|
| Ht. (km) | Pressure (mb) | Temp. (°K) | Density ($g/m^3$) | Water Vapor ($g/m^3$) | Ozone ($g/m^3$) |
| 0 | 1.013E+03 | 300.0 | 1.167E+03 | 1.9E+01 | 5.6E-05 |
| 1 | 9.040E+02 | 294.0 | 1.064E+03 | 1.3E+01 | 5.6E-05 |
| 2 | 8.050E+02 | 288.0 | 9.689E+02 | 9.3E+00 | 5.4E-05 |
| 3 | 7.150E+02 | 284.0 | 8.756E+02 | 4.7E+00 | 5.1E-05 |
| 4 | 6.330E+02 | 277.0 | 7.951E+02 | 2.2E+00 | 4.7E-05 |
| 5 | 5.590E+02 | 270.0 | 7.199E+02 | 1.5E+00 | 4.5E-05 |
| 6 | 4.920E+02 | 264.0 | 6.501E+02 | 8.5E-01 | 4.3E-05 |
| 7 | 4.32 [illegible]02 | 257.0 | 5.855E+02 | 4.7E-01 | 4.1E-05 |
| 8 | 3.7 2 | 250.0 | 5.258E+02 | 2.5E-01 | 3.9E-05 |
| 9 | 3.2[illegible].02 | 244.0 | 4.708E+02 | 1.2E-01 | 3.9E-05 |
| 10 | 2.860E+02 | 237.0 | 4.202E+02 | 5.0E-02 | 3.9E-05 |
| 11 | 2.470E+02 | 230.0 | 3.740E+02 | 1.7E-02 | 4.1E-05 |
| 12 | 2.130E+02 | 224.0 | 3.316E+02 | 6.0E-03 | 4.3E-05 |
| 13 | 1.820E+02 | 217.0 | 2.929E+02 | 1.8E-03 | 4.5E-05 |
| 14 | 1.560E+02 | 210.0 | 2.578E+02 | 1.0E-03 | 4.5E-05 |
| 15 | 1.320E+02 | 204.0 | 2.260E+02 | 7.6E-04 | 4.7E-05 |
| 16 | 1.110E+02 | 197.0 | 1.972E+02 | 6.4E-04 | 4.7E-05 |
| 17 | 9.370E+01 | 195.0 | 1.676E+02 | 5.6E-04 | 6.9E-05 |
| 18 | 7.890E+01 | 199.0 | 1.382E+02 | 5.0E-04 | 9.6E-05 |
| 19 | 6.660E+01 | 203.0 | 1.145E+02 | 4.9E-04 | 1.4E-04 |
| 20 | 5.650E+01 | 207.0 | 9.515E+01 | 4.5E-04 | 1.9E-04 |
| 21 | 4.800E+01 | 211.0 | 7.938E+01 | 5.1E-04 | 2.4E-04 |
| 22 | 4.090E+01 | 215.0 | 6.645E+01 | 5.1E-04 | 2.8E-04 |
| 23 | 3.500E+01 | 217.0 | 5.618E+01 | 5.4E-04 | 3.2E-04 |
| 24 | 3.000E+01 | 219.0 | 4.763E+01 | 6.0E-04 | 3.4E-04 |
| 25 | 2.570E+01 | 221.0 | 4.045E+01 | 6.7E-04 | 3.4E-04 |
| 30 | 1.220E+01 | 232.0 | 1.831E+01 | 3.6E-04 | 2.4E-04 |
| 35 | 6.000E+00 | 243.0 | 8.600E+00 | 1.1E-04 | 9.2E-05 |
| 40 | 3.050E+00 | 254.0 | 4.181E+00 | 4.3E-05 | 4.1E-05 |
| 45 | 1.590E+00 | 265.0 | 2.097E+00 | 1.9E-05 | 1.3E-05 |
| 50 | 8.540E-01 | 270.0 | 1.101E+00 | 6.3E-06 | 4.3E-06 |
| 70 | 5.790E-02 | 219.0 | 9.210E-02 | 1.4E-07 | 8.6E-08 |
| 100 | 3.000E-04 | 210.0 | 5.000E-04 | 1.0E-09 | 4.3E-11 |

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties (Cont.)

| MIDLATITUDE SUMMER | | | | | |
|---|---|---|---|---|---|
| Ht. (km) | Pressure (mb) | Temp. (°K) | Density ($g/m^3$) | Water Vapor ($g/m^3$) | Ozone ($g/m^3$) |
| 0 | 1.013E+03 | 294.0 | 1.191E+03 | 1.4E+01 | 6.0E-05 |
| 1 | 9.020E+02 | 290.0 | 1.080E+03 | 9.3E+00 | 6.0E-05 |
| 2 | 8.020E+02 | 285.0 | 9.757E+02 | 5.9E+00 | 6.0E-05 |
| 3 | 7.100E+02 | 279.0 | 8.846E+02 | 3.3E+00 | 6.2E-05 |
| 4 | 6.280E+02 | 273.0 | 7.998E+02 | 1.9E+00 | 6.4E-05 |
| 5 | 5.540E+02 | 267.0 | 7.211E+02 | 1.0E+00 | 6.6E-05 |
| 6 | 4.870E+02 | 261.0 | 6.487E+02 | 6.1E-01 | 6.9E-05 |
| 7 | 4.260E+02 | 255.0 | 5.830E+02 | 3.7E-01 | 7.5E-05 |
| 8 | 3.720E+02 | 248.0 | 5.225E+02 | 2.1E-01 | 7.9E-05 |
| 9 | 3.240E+02 | 242.0 | 4.669E+02 | 1.2E-01 | 8.6E-05 |
| 10 | 2.810E+02 | 235.0 | 4.159E+02 | 6.4E-02 | 9.0E-05 |
| 11 | 2.430E+02 | 229.0 | 3.693E+02 | 2.2E-02 | 1.1E-04 |
| 12 | 2.090E+02 | 222.0 | 3.269E+02 | 6.0E-03 | 1.2E-04 |
| 13 | 1.790E+02 | 216.0 | 2.882E+02 | 1.8E-03 | 1.5E-04 |
| 14 | 1.530E+02 | 216.0 | 2.464E+02 | 1.0E-03 | 1.8E-04 |
| 15 | 1.300E+02 | 216.0 | 2.104E+02 | 7.6E-04 | 1.9E-04 |
| 16 | 1.110E+02 | 216.0 | 1.797E+02 | 6.4E-04 | 2.1E-04 |
| 17 | 9.500E+01 | 216.0 | 1.535E+02 | 5.6E-04 | 2.4E-04 |
| 18 | 8.120E+01 | 216.0 | 1.305E+02 | 5.0E-04 | 2.8E-04 |
| 19 | 6.950E+01 | 217.0 | 1.110E+02 | 4.9E-04 | 3.2E-04 |
| 20 | 5.[illegible]E+01 | 218.0 | 9.453E+01 | 4.5E-04 | 3.4E-04 |
| 21 | 5.100E+01 | 219.0 | 8.056E+01 | 5.1E-04 | 3.6E-04 |
| 22 | 4.370E+01 | 220.0 | 6.872E+01 | 5.1E-04 | 3.6E-04 |
| 23 | 3.760E+01 | 222.0 | 5.867E+01 | 5.4E-04 | 3.4E-04 |
| 24 | 3.220E+01 | 223.0 | 5.014E+01 | 6.0E-04 | 3.2E-04 |
| 25 | 2.770E+01 | 224.0 | 4.288E+01 | 6.7E-04 | 3.0E-04 |
| 30 | 1.320E+01 | 234.0 | 1.322E+01 | 3.6E-04 | 2.0E-04 |
| 35 | 6.520E+00 | 245.0 | 6.519E+00 | 1.1E-04 | 9.2E-05 |
| 40 | 3.330E+00 | 258.0 | 3.330E+00 | 4.3E-05 | 4.1E-05 |
| 45 | 1.760E+00 | 270.0 | 1.757E+00 | 1.9E-05 | 1.3E-05 |
| 50 | 9.510E-01 | 276.0 | 9.512E-01 | 6.3E-06 | 4.3E-06 |
| 70 | 6.710E-02 | 218.0 | 6.706E-02 | 1.4E-07 | 8.6E-08 |
| 100 | 3.000E-04 | 210.0 | 5.000E-04 | 1.0E-09 | 4.3E-11 |

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties (Cont.)

| MIDLATITUDE WINTER | | | | | |
|---|---|---|---|---|---|
| Ht. (km) | Pressure (mb) | Temp. (°K) | Density ($g/m^3$) | Water Vapor ($g/m^3$) | Ozone ($g/m^3$) |
| 0 | 1.018E+03 | 272.2 | 1.301E+03 | 3.5E+00 | 6.0E-05 |
| 1 | 8.973E+02 | 268.7 | 1.162E+03 | 2.5E+00 | 5.4E-05 |
| 2 | 7.897E+02 | 265.2 | 1.037E+03 | 1.8E+00 | 4.9E-05 |
| 3 | 6.938E+02 | 261.7 | 9.230E+02 | 1.2E+00 | 4.9E-05 |
| 4 | 6.081E+02 | 255.7 | 8.282E+02 | 6.6E-01 | 4.9E-05 |
| 5 | 5.313E+02 | 249.7 | 7.411E+02 | 3.8E-01 | 5.8E-05 |
| 6 | 4.627E+02 | 243.7 | 6.614E+02 | 2.1E-01 | 6.4E-05 |
| 7 | 4.016E+02 | 237.7 | 5.886E+02 | 8.5E-02 | 7.7E-05 |
| 8 | 3.473E+02 | 231.7 | 5.222E+02 | 3.5E-02 | 9.0E-05 |
| 9 | 2.992E+02 | 225.7 | 4.619E+02 | 1.6E-02 | 1.2E-04 |
| 10 | 2.568E+02 | 219.7 | 4.072E+02 | 7.5E-03 | 1.6E-04 |
| 11 | 2.199E+02 | 219.2 | 3.496E+02 | 6.9E-03 | 2.1E-04 |
| 12 | 1.882E+02 | 218.7 | 2.999E+02 | 6.0E-03 | 2.6E-04 |
| 13 | 1.610E+02 | 218.2 | 2.572E+02 | 1.8E-03 | 3.0E-04 |
| 14 | 1.378E+02 | 217.7 | 2.206E+02 | 1.0E-03 | 3.2E-04 |
| 15 | 1.178E+02 | 217.2 | 1.890E+02 | 7.6E-04 | 3.4E-04 |
| 16 | 1.007E+02 | 216.7 | 1.620E+02 | 6.4E-04 | 3.6E-04 |
| 17 | 8.610E+01 | 216.2 | 1.388E+02 | 5.6E-04 | 3.9E-04 |
| 18 | 7.350E+01 | 215.7 | 1.188E+02 | 5.0E-04 | 4.1E-04 |
| 19 | 6.280E+01 | 215.2 | 1.017E+02 | 4.9E-04 | 4.3E-04 |
| 20 | 5.370E+01 | 215.2 | 8.690E+01 | 4.5E-04 | 4.5E-04 |
| 21 | 4.580E+01 | 215.2 | 7.421E+01 | 5.1E-04 | 4.3E-04 |
| 22 | 3.910E+01 | 215.2 | 6.338E+01 | 5.1E-04 | 4.3E-04 |
| 23 | 3.340E+01 | 215.2 | 5.415E+01 | 5.4E-04 | 3.9E-04 |
| 24 | 2.860E+01 | 215.2 | 4.624E+01 | 6.0E-04 | 3.6E-04 |
| 25 | 2.430E+01 | 215.2 | 3.950E+01 | 6.7E-04 | 3.4E-04 |
| 30 | 1.110E+01 | 217.4 | 1.783E+01 | 3.6E-04 | 1.9E-04 |
| 35 | 5.180E+00 | 227.8 | 7.924E+00 | 1.1E-04 | 9.2E-05 |
| 40 | 2.530E+00 | 243.2 | 3.625E+00 | 4.3E-05 | 4.1E-05 |
| 45 | 1.290E+00 | 258.5 | 1.741E+00 | 1.9E-05 | 1.3E-05 |
| 50 | 6.820E-01 | 265.7 | 8.954E-01 | 6.3E-06 | 4.3E-06 |
| 70 | 4.670E-02 | 230.7 | 7.051E-02 | 1.4E-07 | 8.6E-08 |
| 100 | 3.000E-04 | 210.2 | 5.000E-04 | 1.0E-09 | 4.3E-11 |

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties (Cont.)

| SUBARCTIC SUMMER | | | | | |
|---|---|---|---|---|---|
| Ht. (km) | Pressure (mb) | Temp. (°K) | Density ($g/m^3$) | Water Vapor ($g/m^3$) | Ozone ($g/m^3$) |
| 0 | 1.010E+03 | 287.0 | 1.220E+03 | 9.1E+00 | 4.9E-05 |
| 1 | 8.960E+02 | 282.0 | 1.110E+03 | 6.0E+00 | 5.4E-05 |
| 2 | 7.929E+02 | 276.0 | 9.971E+02 | 4.2E+00 | 5.6E-05 |
| 3 | 7.000E+02 | 271.0 | 8.985E+02 | 2.7E+00 | 5.8E-05 |
| 4 | 6.160E+02 | 266.0 | 8.077E+02 | 1.7E+00 | 6.0E-05 |
| 5 | 5.410E+02 | 260.0 | 7.244E+02 | 1.0E+00 | 6.4E-05 |
| 6 | 4.730E+02 | 253.0 | 6.519E+02 | 5.4E-01 | 7.1E-05 |
| 7 | 4.130E+02 | 246.0 | 5.849E+02 | 2.9E-01 | 7.5E-05 |
| 8 | 3.590E+02 | 239.0 | 5.231E+02 | 1.3E-02 | 7.9E-05 |
| 9 | 3.107E+02 | 232.0 | 4.663E+02 | 4.2E-02 | 1.1E-04 |
| 10 | 2.677E+02 | 225.0 | 4.142E+02 | 1.5E-02 | 1.3E-04 |
| 11 | 2.300E+02 | 225.0 | 3.559E+02 | 9.4E-03 | 1.8E-04 |
| 12 | 1.977E+02 | 225.0 | 3.059E+02 | 6.0E-03 | 2.1E-04 |
| 13 | 1.700E+02 | 225.0 | 2.630E+02 | 1.5E-03 | 2.6E-04 |
| 14 | 1.460E+02 | 225.0 | 2.260E+02 | 1.0E-03 | 2.8E-04 |
| 15 | 1.250E+02 | 225.0 | 1.943E+02 | 7.6E-04 | 3.2E-04 |
| 16 | 1.080E+02 | 225.0 | 1.671E+02 | 6.4E-04 | 3.4E-04 |
| 17 | 9.280E+01 | 225.0 | 1.436E+02 | 5.6E-04 | 3.9E-04 |
| 18 | 7.980E+01 | 225.0 | 1.235E+02 | 5.0E-04 | 4.1E-04 |
| 19 | 6.860E+01 | 225.0 | 1.062E+02 | 4.9E-04 | 4.1E-04 |
| 20 | 5.890E+01 | 225.0 | 9.128E+01 | 4.5E-04 | 3.9E-04 |
| 21 | 5.070E+01 | 225.0 | 7.849E+01 | 5.1E-04 | 3.6E-04 |
| 22 | 4.360E+01 | 225.0 | 6.750E+01 | 5.1E-04 | 3.2E-04 |
| 23 | 3.750E+01 | 225.0 | 5.805E+01 | 5.4E-04 | 3.0E-04 |
| 24 | 3.227E+01 | 226.0 | 4.963E+01 | 6.0E-04 | 2.8E-04 |
| 25 | 2.780E+01 | 228.0 | 4.247E+01 | 6.7E-04 | 2.6E-04 |
| 30 | 1.340E+01 | 235.0 | 1.338E+01 | 3.6E-04 | 1.4E-04 |
| 35 | 6.610E+00 | 247.0 | 6.614E+00 | 1.1E-04 | 9.2E-05 |
| 40 | 3.400E+00 | 262.0 | 3.404E+00 | 4.3E-05 | 4.1E-05 |
| 45 | 1.810E+00 | 274.0 | 1.817E+00 | 1.9E-05 | 1.3E-05 |
| 50 | 9.870E-01 | 277.0 | 9.868E-01 | 6.3E-06 | 4.3E-06 |
| 70 | 7.070E-02 | 216.0 | 7.071E-02 | 1.4E-07 | 8.6E-08 |
| 100 | 3.000E-04 | 210.0 | 5.000E-04 | 1.0E-09 | 4.3E-11 |

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties (Cont.)

| SUBARCTIC WINTER | | | | | |
|---|---|---|---|---|---|
| Ht. (km) | Pressure (mb) | Temp. (°K) | Density ($g/m^3$) | Water Vapor ($g/m^3$) | Ozone ($g/m^3$) |
| 0 | 1.013E+03 | 257.1 | 1.372E+03 | 1.2E+00 | 4.1E-05 |
| 1 | 8.878E+02 | 259.1 | 1.193E+03 | 1.2E+00 | 4.1E-05 |
| 2 | 7.775E+02 | 255.9 | 1.058E+03 | 9.4E-01 | 4.1E-05 |
| 3 | 6.798E+02 | 252.7 | 9.366E+02 | 6.8E-01 | 4.3E-05 |
| 4 | 5.932E+02 | 247.7 | 8.339E+02 | 4.1E-01 | 4.5E-05 |
| 5 | 5.158E+02 | 240.9 | 7.457E+02 | 2.0E-01 | 4.7E-05 |
| 6 | 4.467E+02 | 234.1 | 6.646E+02 | 9.8E-02 | 4.9E-05 |
| 7 | 3.853E+02 | 227.3 | 5.904E+02 | 5.4E-02 | 7.1E-05 |
| 8 | 3.308E+02 | 220.6 | 5.226E+02 | 1.1E-02 | 9.0E-05 |
| 9 | 2.829E+02 | 217.2 | 4.538E+02 | 8.4E-03 | 1.6E-04 |
| 10 | 2.418E+02 | 217.2 | 3.879E+02 | 5.5E-03 | 2.4E-04 |
| 11 | 2.067E+02 | 217.2 | 3.315E+02 | 3.8E-03 | 3.2E-04 |
| 12 | 1.766E+02 | 217.2 | 2.834E+02 | 2.6E-03 | 4.3E-04 |
| 13 | 1.510E+02 | 217.2 | 2.422E+02 | 1.8E-03 | 4.7E-04 |
| 14 | 1.291E+02 | 217.2 | 2.071E+02 | 1.0E-03 | 4.9E-04 |
| 15 | 1.103E+02 | 217.2 | 1.770E+02 | 7.6E-04 | 5.6E-04 |
| 16 | 9.431E+01 | 216.6 | 1.517E+02 | 6.4E-04 | 6.2E-04 |
| 17 | 8.058E+01 | 216.0 | 1.300E+02 | 5.6E-04 | 6.2E-04 |
| 18 | 6.882E+01 | 215.4 | 1.113E+02 | 5.0E-04 | 6.2E-04 |
| 19 | 5.875E+01 | 214.8 | 9.529E+01 | 4.9E-04 | 6.0E-04 |
| 20 | 5.014E+01 | 214.1 | 8.155E+01 | 4.5E-04 | 5.6E-04 |
| 21 | 4.277E+01 | 213.6 | 6.976E+01 | 5.1E-04 | 5.1E-04 |
| 22 | 3.647E+01 | 213.0 | 5.966E+01 | 5.1E-04 | 4.7E-04 |
| 23 | 3.109E+01 | 212.4 | 5.100E+01 | 5.4E-04 | 4.3E-04 |
| 24 | 2.649E+01 | 211.8 | 4.358E+01 | 6.0E-04 | 3.6E-04 |
| 25 | 2.256E+01 | 211.2 | 3.722E+01 | 6.7E-04 | 3.2E-04 |
| 30 | 1.020E+01 | 216.0 | 1.645E+01 | 3.6E-04 | 1.5E-04 |
| 35 | 4.701E+00 | 222.2 | 7.368E+00 | 1.1E-04 | 9.2E-05 |
| 40 | 2.243E+00 | 234.7 | 3.330E+00 | 4.3E-05 | 4.1E-05 |
| 45 | 1.113E+00 | 247.0 | 1.569E+00 | 1.9E-05 | 1.3E-05 |
| 50 | 5.719E-01 | 259.3 | 7.682E-01 | 6.3E-06 | 4.3E-06 |
| 70 | 4.016E-02 | 245.7 | 5.695E-02 | 1.4E-07 | 8.6E-08 |
| 100 | 3.000E-04 | 210.0 | 5.000E-04 | 1.0E-09 | 4.3E-11 |

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties (Cont.)

| U.S. STANDARD ATMOSPHERE, 1962 | | | | | |
|---|---|---|---|---|---|
| Ht. (km) | Pressure (mb) | Temp. (°K) | Density ($g/m^3$) | Water Vapor ($g/m^3$) | Ozone ($g/m^3$) |
| 0 | 1.013E+03 | 288.1 | 1.225E+03 | 5.9E+00 | 5.4E-05 |
| 1 | 8.986E+02 | 281.6 | 1.111E+03 | 4.2E+00 | 5.4E-05 |
| 2 | 7.950E+02 | 275.1 | 1.007E+03 | 2.9E+00 | 5.4E-05 |
| 3 | 7.012E+02 | 268.7 | 9.093E+02 | 1.8E+00 | 5.0E-05 |
| 4 | 6.166E+02 | 262.2 | 8.193E+02 | 1.1E+00 | 4.6E-05 |
| 5 | 5.405E+02 | 255.7 | 7.364E+02 | 6.4E-01 | 4.5E-05 |
| 6 | 4.722E+02 | 249.2 | 6.601E+02 | 3.8E-01 | 4.5E-05 |
| 7 | 4.111E+02 | 242.7 | 5.900E+02 | 2.1E-01 | 4.8E-05 |
| 8 | 3.565E+02 | 236.2 | 5.258E+02 | 1.2E-01 | 5.2E-05 |
| 9 | 3.080E+02 | 229.7 | 4.671E+02 | 4.6E-02 | 7.1E-05 |
| 10 | 2.650E+02 | 223.2 | 4.135E+02 | 1.8E-02 | 9.0E-05 |
| 11 | 2.270E+02 | 216.8 | 3.648E+02 | 8.2E-03 | 1.3E-04 |
| 12 | 1.940E+02 | 216.6 | 3.118E+02 | 3.7E-03 | 1.8E-04 |
| 13 | 1.658E+02 | 216.6 | 2.666E+02 | 1.8E-03 | 1.7E-04 |
| 14 | 1.417E+02 | 216.6 | 2.279E+02 | 3.4E-04 | 1.9E-04 |
| 15 | 1.211E+02 | 216.6 | 1.948E+02 | 7.2E-04 | 2.1E-04 |
| 16 | 1.035E+02 | 216.6 | 1.665E+02 | 6.1E-04 | 2.3E-04 |
| 17 | 8.850E+01 | 216.6 | 1.423E+02 | 5.2E-04 | 2.8E-04 |
| 18 | 7.565E+01 | 216.6 | 1.216E+02 | 4.4E-04 | 3.2E-04 |
| 19 | 6.467E+01 | 216.6 | 1.040E+02 | 4.4E-04 | 3.5E-04 |
| 20 | 5.529E+01 | 216.6 | 8.891E+01 | 4.4E-04 | 3.8E-04 |
| 21 | 4.729E+01 | 217.6 | 7.572E+01 | 4.8E-04 | 3.8E-04 |
| 22 | 4.047E+01 | 218.6 | 6.451E+01 | 5.2E-04 | 3.9E-04 |
| 23 | 3.467E+01 | 219.6 | 5.500E+01 | 5.7E-04 | 3.8E-04 |
| 24 | 2.972E+01 | 220.6 | 4.694E+01 | 6.1E-04 | 3.6E-04 |
| 25 | 2.549E+01 | 221.6 | 4.008E+01 | 6.6E-04 | 3.4E-04 |
| 30 | 1.197E+01 | 226.5 | 1.841E+01 | 3.8E-04 | 2.0E-04 |
| 35 | 5.746E+00 | 236.5 | 8.463E+00 | 1.6E-04 | 1.1E-04 |
| 40 | 2.871E+00 | 250.4 | 3.996E+00 | 6.7E-05 | 4.9E-05 |
| 45 | 1.491E+00 | 264.2 | 1.966E+00 | 3.2E-05 | 1.7E-05 |
| 50 | 7.978E-01 | 270.6 | 1.027E+00 | 1.2E-05 | 4.0E-06 |
| 70 | 5.520E-02 | 219.7 | 8.754E-02 | 1.5E-07 | 8.6E-08 |
| 100 | 3.008E-04 | 210.0 | 4.989E-04 | 1.0E-09 | 4.3E-11 |

## 5. COMPUTATIONAL TECHNIQUES FOR MOLECULAR ABSORPTION

A Lorentz line profile as given in Eq. (4) was assumed for each line in the lower atmosphere except as modified (see Section 2) for carbon dioxide lines.

$$k = \frac{S\alpha}{\pi[(\nu - \nu_o)^2 + \alpha^2]} \tag{4}$$

In Eq. (4), S is the line intensity, $\alpha$ is the half-width, $\nu_o$ the central line frequency, and $\nu$ the laser frequency. For pressures less than 10 mb, a Voigt profile[15] is used in the calculations. The laser frequency ($\nu$) is assumed monochromatic for the purposes of this calculation. In general, a large number of absorption lines belonging to different molecules contribute to the attenuation at any specific laser frequency, so the total absorption coefficient must be evaluated as indicated by Eq. (5)

$$k_m = \sum_j \sum_i \frac{S_{ij}\, \alpha_{ij}\, m_j}{\pi[(\nu - \nu_{ij})^2 + \alpha_{ij}^2]} \tag{5}$$

where $m_j$ represents the amount of the $j^{th}$ absorbing gas and where i is an index over all lines belonging to the same molecular specie and $m_j$ is the molecular abundance of the $j^{th}$ molecular species per kilometer.

Pressure broadening enters through the $\alpha$ values, the Lorentz line width being given by $\alpha = \alpha_o\ P/P_o\ \sqrt{T_o/T}$. The line intensity (S) is also temperature dependent through the population of the lower state of the transition and through the partition functions. These temperature and pressure effects have been included for all lines. As indicated in Section 2, the LASER program considers all line wings within 20 $cm^{-1}$ of the laser frequency in question as contributing to the absorption coefficient and all lines outside of this 20 $cm^{-1}$ limit are omitted in the calculation.

The extinction due to molecular scattering, aerosol absorption and aerosol scattering are separately computed and tabulated in the output from LASER. The total extinction coefficient for a given path can then be obtained by summing these four components as indicated in Eq. (1). The transmission for a horizontal path is then given by Eq. (6) where $\tau$ is the transmission and R is the range in kilometers

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15. Young, C. (1965) J. Quant. Spectrosc. Radiative Transfer 5:549.

$$\tau(\nu) = \exp\left[-\gamma(\nu)\, R\right] \quad . \tag{6}$$

## 6. RESULTS

The results we wish to describe here fall into three categories: (1) The LASER Computer Code which will be described and documented in Appendix A; (2) Extinction Coefficients for a number of specific laser frequencies generated with the LASER computer program (see Appendix B); and (3) High resolution spectral plots covering the regions between 740 and 1400 $cm^{-1}$ (7.1 and 13.5 $\mu$m), 1880 and 2180 $cm^{-1}$ (4.6 and 5.3 $\mu$m) and 2360 and 2960 $cm^{-1}$ (3.4 and 4.2 $\mu$m) which are given in Appendix C. We have provided spectra in Appendix C covering the regions of laser emission by $CO_2$, CO, and DF. We wish to emphasize differences in the continuum model for water vapor in both the 8 to 14-$\mu$m region (740 to 1400 $cm^{-1}$) and the 3.5 to 4.2-$\mu$m regions (2360 to 3020 $cm^{-1}$) as well as some modifications of individual line parameters primarily in the 3.5 to 4.2 $\mu$m region. These "infinite" resolution spectra have been generated by performing monochromatic calculations at steps of 0.01 $cm^{-1}$ over the entire range of frequency of each plot. Such spectral plots can be generated with the computer program provided in Reference 1 and the AFGL Atmospheric Line Parameters Compilation discussed in Section 1 of this report. Figure C1 provides spectra for a 10-km horizontal path at sea level and Figure C2 provides spectra for a 10-km horizontal path at an altitude of 12 km.

Table 7 contains a detailed list of all laser frequencies for which extinction coefficients were provided in an earlier report.[5] Based on our more up-to-date absorption modeling, we have included revised molecular absorption coefficients in Table 7, containing contributions from both discrete lines and molecular continuum absorption for three of the model atmospheres described in Table 5 at sea level (Tropical, U.S. Standard, and Subarctic Winter) and for the 11 to 12-km altitude layer (only for the U.S. Standard Atmosphere).

A comparison of Table 7 with a similar table in Reference 5 indicates the following: (1) Somewhat lower absorption coefficients for most of the $CO_2$ emission lines. This is principally due to the modifications made to the water vapor continuum absorption. Occasionally, a line (such as the P40 line of $CO_2$) shows a drastic increase due to an error made in the earlier report. (2) The DF laser emission region shows a significant increase principally due to the inclusion of the water vapor continuum - absorption by the water vapor continuum was omitted in this spectral region in the earlier calculations. Occasionally the changes differ

Table 7. Attenuation Coefficients for Laser Frequencies

| $CO_2$ Laser Parameters | | Atmospheric Absorption Coefficients ($km^{-1}$) | | | |
|---|---|---|---|---|---|
| 00011 → 10001 | | Height = 0 km (Sea Level) | | | Height = 11-12 km |
| Rot. ID | $\nu(cm^{-1})$ | $K_{trop.}$ | $K_{U.S.\ Std.}$ | $K_{sw}$ | $K_{U.S.\ Std.}$ |
| *P40 | 924.975 | 3.95 | 1.09 | 0.150 | 0.00150 |
| P38 | 927.009 | 0.423 | 0.0718 | 0.0121 | 0.00108 |
| P36 | 929.018 | 0.698 | 0.128 | 0.0163 | 0.00149 |
| P34 | 931.002 | 0.428 | 0.0807 | 0.0164 | 0.00203 |
| P32 | 932.961 | 0.432 | 0.0856 | 0.0190 | 0.00273 |
| P30 | 934.895 | 0.442 | 0.0926 | 0.0220 | 0.00344 |
| P28 | 936.805 | 0.445 | 0.0991 | 0.0255 | 0.00431 |
| P26 | 938.689 | 0.449 | 0.105 | 0.0287 | 0.00533 |
| P24 | 940.549 | 0.458 | 0.111 | 0.0320 | 0.00632 |
| *P22 | 942.384 | 0.460 | 0.116 | 0.0353 | 0.00741 |
| *P20 | 944.195 | 0.480 | 0.125 | 0.0386 | 0.00838 |
| *P18 | 945.981 | 0.468 | 0.124 | 0.398 | 0.00905 |
| *P16 | 947.743 | 0.523 | 0.138 | 0.0426 | 0.00968 |
| P14 | 949.480 | 0.467 | 0.124 | 0.0409 | 0.00982 |
| P12 | 951.193 | 0.450 | 0.118 | 0.0392 | 0.00970 |
| P10 | 952.882 | 0.450 | 0.113 | 0.0364 | 0.00900 |
| P8 | 954.546 | 0.437 | 0.104 | 0.0321 | 0.00786 |
| P6 | 956.186 | 0.417 | 0.0917 | 0.0266 | 0.00640 |
| P4 | 957.802 | 0.391 | 0.0766 | 0.0198 | 0.00448 |
| *P2 | 959.393 | 0.432 | 0.0742 | 0.0133 | 0.00235 |
| R0 | 961.734 | 0.386 | 0.0597 | 0.00897 | 0.00117 |
| R2 | 963.264 | 0.376 | 0.0689 | 0.0163 | 0.00349 |
| R4 | 964.770 | 0.373 | 0.0830 | 0.0234 | 0.00560 |
| R6 | 966.251 | 0.427 | 0.100 | 0.0304 | 0.00752 |
| R8 | 967.708 | 0.424 | 0.108 | 0.0357 | 0.00908 |
| R10 | 969.141 | 0.430 | 0.116 | 0.0396 | 0.0101 |
| R12 | 970.548 | 0.536 | 0.141 | 0.0436 | 0.0107 |
| R14 | 971.931 | 0.473 | 0.132 | 0.0443 | 0.0108 |
| *R16 | 973.289 | 0.523 | 0.144 | 0.0454 | 0.0106 |
| *R18 | 974.623 | 0.452 | 0.129 | 0.0432 | 0.0100 |
| *R20 | 975.931 | 1.32 | 0.329 | 0.0602 | 0.00906 |
| *R22 | 977.215 | 0.552 | 0.147 | 0.0407 | 0.00805 |
| R24 | 978.473 | 0.425 | 0.111 | 0.0339 | 0.00687 |
| R26 | 979.706 | 0.409 | 0.103 | 0.0301 | 0.00578 |
| R28 | 980.919 | 0.402 | 0.0966 | 0.0266 | 0.00476 |
| R30 | 982.097 | 0.485 | 0.115 | 0.0261 | 0.00380 |
| R32 | 983.253 | 0.380 | 0.0817 | 0.0196 | 0.00323 |
| R34 | 984.384 | 0.392 | 0.0796 | 0.0169 | 0.00231 |
| R36 | 985.489 | 0.360 | 0.0684 | 0.0138 | 0.00177 |
| R38 | 986.568 | 0.352 | 0.0633 | 0.0117 | 0.00128 |
| R40 | 987.621 | 0.345 | 0.0590 | 0.0101 | 0.00109 |
| 00011 → 10002 | | | | | |
| *P20 | 1046.854 | 0.409 | 0.142 | 0.0588 | 0.0364 |
| *P18 | 1048.661 | 0.430 | 0.152 | 0.0650 | 0.0672 |
| *P16 | 1050.441 | 0.452 | 0.164 | 0.0735 | 0.0647 |
| *R16 | 1075.988 | 0.473 | 0.162 | 0.0614 | 0.0168 |
| *R18 | 1077.303 | 0.403 | 0.144 | 0.0581 | 0.0159 |
| *R20 | 1078.591 | 0.400 | 0.139 | 0.0546 | 0.0151 |

Table 7. Attenuation Coefficients for Laser Frequencies (Cont.)

| DF Laser Parameter | | | Atmospheric Absorption Coefficients ($km^{-1}$) Height - 0 km (Sea Level) | | | Height = 11-12 km |
|---|---|---|---|---|---|---|
| Band | Rot. ID | $\nu(cm^{-1})$ | $K_{trop.}$ | $K_{U.S.\ Std.}$ | $K_{sw}$ | $K_{U.S.\ Std.}$ |
| 1-0 | P1 | 2884.934 | 0.123 | 0.0612 | 0.0374 | 5.91E-3 |
| | P2 | 2862.652 | 0.0617 | 0.0320 | 0.0156 | 4.07E-4 |
| | P3 | 2839.779 | 0.0695 | 0.0225 | 4.73E-3 | 7.57E-5 |
| | P4 | 2816.362 | 0.0688 | 0.0215 | 5.19E-3 | 1.02E-4 |
| | P5 | 2792.437 | 0.0927 | 0.0302 | 9.48E-3 | 1.34E-4 |
| | P6 | 2767.914 | 0.119 | 0.0410 | 0.0159 | 7.63E-4 |
| | P7 | 2743.028 | 0.0449 | 0.0160 | 7.00E-3 | 1.53E-4 |
| | *P8 | 2717.536 | 0.227 | 0.0682 | 0.0162 | 1.62E-4 |
| | P9 | 2691.409 | 0.0504 | 0.0189 | 9.45E-3 | 1.19E-3 |
| | *P10 | 2665.20 | 0.0611 | 0.0245 | 0.0143 | 1.40E-3 |
| | P11 | 2638.396 | 0.531 | 0.164 | 0.0383 | 3.56E-4 |
| | P12 | 2611.125 | 0.0347 | 0.0127 | 5.83E-3 | 1.14E-4 |
| | P13 | 2584.91 | 0.0445 | 0.0219 | 0.0156 | 5.76E-4 |
| | P14 | 2557.09 | 0.0477 | 0.0309 | 0.0280 | 6.40E-3 |
| | P15 | 2527.06 | 0.0426 | 0.0241 | 0.0195 | 6.20E-4 |
| | P16 | 2498.02 | 0.0602 | 0.0375 | 0.0330 | 1.11E-3 |
| 2-1 | P3 | 2750.05 | 0.0710 | 0.0245 | 0.00954 | 2.53E-4 |
| | P4 | 2727.38 | 0.0663 | 0.0219 | 0.00747 | 9.91E-5 |
| | P5 | 2703.98 | 0.0408 | 0.0140 | 0.00562 | 1.03E-4 |
| | *P6 | 2680.28 | 0.114 | 0.0391 | 0.0150 | 5.06E-4 |
| | P7 | 2655.97 | 0.106 | 0.0378 | 0.0167 | 5.93E-3 |
| | *P8 | 2631.09 | 0.0382 | 0.0156 | 0.00947 | 3.23E-3 |
| | P9 | 2605.87 | 0.0820 | 0.0268 | 0.00924 | 1.82E-4 |
| | *P10 | 2580.16 | 0.0560 | 0.0373 | 0.0346 | 2.28E-3 |
| | P11 | 2553.97 | 0.0419 | 0.0256 | 0.0232 | 1.15E-3 |
| | P12 | 2527.47 | 0.0426 | 0.0247 | 0.0206 | 1.76E-3 |
| | P13 | 2500.32 | 0.0553 | 0.0360 | 0.0327 | 1.76E-3 |
| | P16 | 2417.27 | 0.125 | 0.0990 | 0.0994 | 3.52E-3 |
| 3-2 | P3 | 2662.17 | 0.0611 | 0.0208 | 0.00773 | 1.92E-4 |
| | P4 | 2640.04 | 0.0866 | 0.0301 | 0.0109 | 6.23E-4 |
| | P5 | 2617.41 | 0.0316 | 0.0119 | 0.00592 | 1.53E-4 |
| | P6 | 2594.23 | 0.0458 | 0.0179 | 0.00904 | 2.31E-4 |
| | P7 | 2570.51 | 0.0733 | 0.0510 | 0.0510 | 7.29E-3 |
| | *P8 | 2546.37 | 0.0611 | 0.0432 | 0.0420 | 3.16E-3 |
| | P9 | 2521.81 | 0.0432 | 0.0248 | 0.0204 | 6.50E-4 |
| | *P10 | 2496.61 | 0.0631 | 0.0391 | 0.0342 | 1.15E-3 |
| | P11 | 2471.34 | 0.0866 | 0.0596 | 0.0557 | 2.03E-3 |
| | P12 | 2445.29 | 0.106 | 0.0820 | 0.0806 | 2.85E-3 |
| | P13 | 2419.02 | 0.124 | 0.0975 | 0.0978 | 3.47E-3 |
| | P14 | 2392.46 | 0.194 | 0.149 | 0.125 | 4.06E-3 |
| 4-3 | P5 | 2532.50 | 0.0414 | 0.0228 | 0.0181 | 5.73E-4 |
| | P6 | 2509.86 | 0.0490 | 0.0302 | 0.0261 | 8.67E-4 |
| | P7 | 2486.83 | 0.0652 | 0.0440 | 0.0406 | 1.45E-3 |
| | *P8 | 2463.25 | 0.108 | 0.0695 | 0.0624 | 2.47E-3 |
| | P9 | 2439.29 | 0.110 | 0.086 | 0.085 | 3.06E-3 |
| | *P10 | 2414.89 | 0.128 | 0.101 | 0.102 | 3.62E-3 |
| 5-4 | P7 | 2404.63 | 0.135 | 0.106 | 0.106 | 3.77E-3 |
| 7-6 | P8 | 2222.68 | 0.344 | 0.327 | 0.299 | 2.30E-2 |
| | *P10 | 2177.99 | 0.0874 | 0.0738 | 0.0599 | 1.99E-3 |
| | P11 | 2155.03 | 0.220 | 0.0677 | 0.0254 | 1.06E-3 |
| | P12 | 2131.68 | 0.290 | 0.180 | 0.175 | 4.09E-2 |

Table 7. Attenuation Coefficients for Laser Frequencies (Cont.)

| DF Laser Parameter (Cont.) | | | Atmospheric Absorption Coefficients ($km^{-1}$) Height - 0 km (Sea Level) | | | Height = 11-12 km |
|---|---|---|---|---|---|---|
| Band | Rot. ID | $\nu(cm^{-1})$ | $K_{trop.}$ | $K_{U.S.\ Std.}$ | $K_{sw}$ | $K_{U.S.\ Std.}$ |
| 8-7 | P7 | 2165.93 | 0.0626 | 0.0423 | 0.0408 | 2.05E-3 |
| | P8 | 2144.80 | 1.55 | 0.377 | 0.0399 | 3.43E-4 |
| | P9 | 2123.24 | 0.259 | 0.0698 | 0.0190 | 3.63E-3 |
| | *P10 | 2101.27 | 0.172 | 0.0584 | 0.0225 | 6.67E-3 |
| | P12 | 2056.14 | 0.144 | 0.0449 | 0.0192 | 7.67E-4 |
| | P13 | 2033.01 | 0.190 | 0.0472 | 0.00617 | 1.36E-5 |
| 9-8 | P6 | 2108.48 | 0.0686 | 0.0229 | 0.00897 | 4.93E-3 |
| | P7 | 2088.34 | 0.562 | 0.140 | 0.0210 | 4.89E-3 |
| | P8 | 2067.76 | 0.932 | 0.262 | 0.0768 | 3.93E-5 |
| | *P10 | 2025.36 | 0.855 | 0.209 | 0.0277 | 2.73E-5 |
| | P11 | 2003.56 | 0.441 | 0.111 | 0.0148 | 1.50E-5 |
| | P12 | 1981.38 | 0.623 | 0.149 | 0.0187 | 1.08E-5 |

| HF Laser Parameter | | | Atmospheric Absorption Coefficients ($km^{-1}$) Height - 0 km (Sea Level) | | | Height = 11-12 km |
|---|---|---|---|---|---|---|
| Band | Rot. ID | $\nu(cm^{-1})$ | $K_{trop.}$ | $K_{U.S.\ Std.}$ | $K_{sw}$ | $K_{U.S.\ Std.}$ |
| 1-0 | P11 | 3436.12 | 1.74 | 0.401 | 0.0449 | 0.00033 |
| | P12 | 3381.50 | 0.512 | 0.139 | 0.0237 | 0.00033 |
| 2-1 | *P8 | 3435.17 | 0.987 | 0.265 | 0.0400 | 0.00094 |
| 3-2 | P6 | 3373.46 | 0.354 | 0.0952 | 0.0169 | 0.00091 |
| 4-3 | P8 | 3130.09 | 0.698 | 0.212 | 0.0508 | 0.00025 |
| | P9 | 3083.83 | 1.14 | 0.356 | 0.0862 | 0 00153 |
| 5-4 | P4 | 3150.67 | 0.289 | 0.0837 | 0.0167 | 0.00004 |
| | *P6 | 2921.74 | 0.0231 | 0.00738 | 0.00300 | 0.000121 |
| | *P7 | 2680.70 | 0.0176 | 0.00494 | 0.000889 | 1.0E-6 |
| | P8 | 2838.59 | 0.323 | 0.0983 | 0.0190 | 0.000037 |

Table 7. Attenuation Coefficients for Laser Frequencies (Cont.)

| CO Laser Parameters | | | Atmospheric Absorption Coefficients ($km^{-1}$) Height - 0 km (Sea Level) | | | Height = 11-12 km |
|---|---|---|---|---|---|---|
| Band | Rot. ID | $\nu(cm^{-1})$ | $K_{trop.}$ | $K_{U.S.\ Std.}$ | $K_{sw}$ | $K_{U.S.\ Std.}$ |
| 1-0 | P2 | 2135.549 | 0.743 | 0.278 | 0.168 | 1.87E-1 |
| | *P14 | 2086.325 | 0.465 | 0.244 | 0.170 | 1.32E-1 |
| | P17 | 2073.267 | 0.703 | 0.257 | 0.108 | 5.00E-2 |
| | P18 | 2068.849 | 0.329 | 0.159 | 0.106 | 3.65E-2 |
| | P21 | 2055.402 | 0.173 | 0.108 | 0.0874 | 1.23E-2 |
| | P22 | 2050.856 | 0.184 | 0.0813 | 0.0465 | 6.71E-3 |
| | P25 | 2037.027 | 0.520 | 0.148 | 0.0344 | 1.82E-3 |
| | P26 | 2032.354 | 0.221 | 0.0665 | 0.0158 | 9.88E-4 |
| | P27 | 2027.651 | 0.853 | 0.245 | 0.0488 | 9.82E-4 |
| | P30 | 2013.353 | 0.603 | 0.158 | 0.0235 | 8.86E-5 |
| 2-1 | P1 | 2112.977 | 0.120 | 0.0324 | 0.00766 | 4.68E-4 |
| | P2 | 2109.132 | 0.0695 | 0.0314 | 0.0183 | 6.95E-3 |
| | P3 | 2105.256 | 0.131 | 0.0408 | 0.0113 | 2.73E-3 |
| | P4 | 2101.342 | 0.144 | 0.0448 | 0.0142 | 3.76E-3 |
| | P7 | 2089.393 | 1.95 | 0.480 | 0.0601 | 4.81E-3 |
| | P8 | 2085.343 | 0.232 | 0.0716 | 0.0303 | 2.57E-3 |
| | P9 | 2081.258 | 0.189 | 0.0551 | 0.0155 | 1.14E-3 |
| | P11 | 2072.987 | 0.421 | 0.129 | 0.0353 | 1.94E-3 |
| | P12 | 2068.802 | 0.295 | 0.125 | 0.0753 | 5.21E-3 |
| | *P15 | 2056.046 | 0.193 | 0.0526 | 0.0171 | 6.51E-4 |
| | P16 | 2051.729 | 1.42 | 0.317 | 0.0375 | 9.25E-4 |
| | P17 | 2047.379 | 0.457 | 0.161 | 0.0715 | 2.63E-3 |
| | P19 | 2038.582 | 0.450 | 0.123 | 0.0242 | 2.92E-4 |
| | P21 | 2029.656 | 0.195 | 0.0521 | 0.00853 | 3.25E-5 |
| | P22 | 2025.145 | 0.650 | 0.166 | 0.0237 | 3.02E-5 |
| | P25 | 2011.423 | 0.498 | 0.130 | 0.0184 | 1.45E-5 |
| | P26 | 2006.786 | 0.977 | 0.249 | 0.0332 | 1.90E-5 |
| | P27 | 2002.118 | 0.357 | 0.0968 | 0.0159 | 1.29E-5 |
| | P28 | 1997.419 | 1.07 | 0.297 | 0.0519 | 4.07E-5 |
| 3-2 | P1 | 2086.594 | 0.474 | 0.122 | 0.0246 | 2.20E-3 |
| | P2 | 2082.784 | 0.128 | 0.0372 | 0.0110 | 8.42E-4 |
| | P3 | 2078.940 | 0.778 | 0.270 | 0.116 | 3.72E-2 |
| | P4 | 2075.061 | 0.388 | 0.110 | 0.0249 | 3.47E-3 |
| | P5 | 2071.148 | 0.148 | 0.0449 | 0.0157 | 9.87E-4 |
| | P6 | 2067.200 | 0.816 | 0.232 | 0.0629 | 2.50E-3 |
| | P7 | 2063.218 | 0.968 | 0.274 | 0.0723 | 2.45E-3 |
| | P8 | 2059.203 | 0.641 | 0.182 | 0.0423 | 9.16E-4 |
| | P10 | 2951.071 | 0.425 | 0.123 | 0.0263 | 6.10E-4 |
| | P11 | 2046.954 | 1.07 | 0.264 | 0.0358 | 2.34E-4 |
| | P12 | 2042.864 | 1.80 | 0.489 | 0.0903 | 8.93E-4 |
| | P13 | 2038.621 | 0.452 | 0.121 | 0.0215 | 2.48E-4 |
| | P14 | 2034.405 | 1.11 | 0.259 | 0.0255 | 3.24E-5 |
| | *P15 | 2030.157 | 0.440 | 0.111 | 0.0144 | 1.64E-5 |
| | P16 | 2025.875 | 1.33 | 0.349 | 0.0539 | 6.55E-5 |
| | P17 | 2021.561 | 0.897 | 0.227 | 0.0307 | 8.00E-5 |
| | P19 | 2012.835 | 0.693 | 0.184 | 0.0262 | 2.75E-5 |
| | P20 | 2008.424 | 1.99 | 0.511 | 0.0704 | 4.18E-5 |
| | P21 | 2003.981 | 0.360 | 0.0921 | 0.0137 | 1.46E-4 |
| | P25 | 1985.891 | 1.38 | 0.368 | 0.0550 | 3.32E-5 |
| | P26 | 1981.290 | 1.12 | 0.244 | 0.0241 | 1.18E-5 |

Table 7. Attenuation Coefficients for Laser Frequencies (Cont.)

| CO Laser Parameters (Cont.) | | | Atmospheric Absorption Coefficients ($km^{-1}$) Height - 0 km (Sea Level) | | | Height = 11-12 km |
|---|---|---|---|---|---|---|
| Band | Rot. ID | $\nu(cm^{-1})$ | $K_{trop.}$ | $K_{U.S.\ Std.}$ | $K_{sw}$ | $K_{U.S.\ Std.}$ |
| 3-2 | P27 | 1976.658 | 1.26 | 0.36 | 0.0735 | 8.21E-5 |
| | P28 | 1971.995 | 0.709 | 0.192 | 0.0310 | 4.77E-5 |
| | P30 | 1962.577 | 1.57 | 0.428 | 0.0690 | 5.50E-5 |
| 4-3 | P2 | 2056.506 | 0.177 | 0.105 | 0.0891 | 4.73E-3 |
| | P3 | 2052.697 | 0.144 | 0.0443 | 0.0154 | 4.86E-4 |
| | P4 | 2048.853 | 0.358 | 0.119 | 0.0521 | 1.92E-3 |
| | P5 | 2044.975 | 0.907 | 0.250 | 0.0444 | 2.17E-4 |
| | P7 | 2037.116 | 0.666 | 0.178 | 0.0356 | 5.13E-3 |
| | P8 | 2033.135 | 0.215 | 0.0529 | 6.75E-3 | 1.51E-5 |
| | P9 | 2029.121 | 0.206 | 0.0563 | 0.0101 | 8.78E-5 |
| | P10 | 2025.074 | 0.599 | 0.155 | 0.0229 | 6.88E-5 |
| | P11 | 2020.993 | 1.01 | 0.260 | 0.0359 | 3.06E-5 |
| | P13 | 2012.731 | 0.691 | 0.185 | 0.0262 | 3.66E-5 |
| | P14 | 2008.550 | 1.69 | 0.441 | 0.0636 | 5.12E-5 |
| | *P15 | 2004.337 | 0.362 | 0.0915 | 0.0126 | 1.73E-5 |
| | P17 | 1995.812 | 1.32 | 0.351 | 0.0545 | 3.56E-5 |
| | P20 | 1982.783 | 0.759 | 0.205 | 0.0304 | 2.71E-5 |
| | P21 | 1978.375 | 0.323 | 0.0878 | 0.0146 | 3.05E-5 |
| | P22 | 1973.936 | 0.444 | 0.121 | 0.0196 | 1.53E-5 |
| 5-4 | P2 | 2030.297 | 0.414 | 0.104 | 0.0135 | 1.89E-5 |
| | P6 | 2014.993 | 1.96 | 0.509 | 0.0731 | 1.46E-4 |
| | *P7 | 2011.082 | 0.589 | 0.154 | 0.0220 | 1.54E-5 |
| | P8 | 2007.107 | 2.08 | 0.528 | 0.0696 | 1.78E-4 |
| | P9 | 2003.158 | 0.449 | 0.114 | 0.0156 | 1.06E-5 |
| | P11 | 1995.100 | 1.90 | 0.504 | 0.0778 | 5.16E-5 |
| | *P14 | 1982.764 | 0.784 | 0.213 | 0.0311 | 4.00E-5 |
| | *P15 | 1978.586 | 0.309 | 0.0836 | 0.0136 | 1.67E-5 |
| | *P16 | 1974.376 | 0.461 | 0.125 | 0.0201 | 1.52E-5 |
| | P21 | 1952.238 | 1.04 | 0.284 | 0.0474 | 4.43E-5 |
| | P25 | 1935.035 | 1.50 | 0.408 | 0.0720 | 1.72E-3 |
| | P26 | 1930.506 | 1.37 | 0.373 | 0.0610 | 7.10E-5 |
| 6-5 | P2 | 2004.155 | 0.820 | 0.187 | 0.0179 | 5.04E-5 |
| | P3 | 2000.415 | 0.892 | 0.249 | 0.0447 | 3.69E-5 |
| | P4 | 1996.641 | 1.22 | 0.316 | 0.0475 | 5.07E-5 |
| | P7 | 1985.115 | 0.835 | 0.221 | 0.0331 | 2.73E-5 |
| | P8 | 1981.205 | 2.30 | 0.481 | 0.0369 | 1.52E-5 |
| | P9 | 1977.261 | 0.516 | 0.143 | 0.0252 | 2.11E-5 |
| | P10 | 1973.284 | 0.502 | 0.136 | 0.0218 | 2.31E-5 |
| | *P15 | 1952.901 | 1.06 | 0.290 | 0.0482 | 4.29E-5 |
| | P19 | 1936.007 | 1.42 | 0.386 | 0.0643 | 1.20E-4 |
| 7-6 | P3 | 1974.409 | 0.453 | 0.123 | 0.0200 | 1.49E-5 |
| | P4 | 1970.670 | 1.30 | 0.348 | 0.0543 | 3.77E-5 |
| | P6 | 1963.089 | 1.41 | 0.381 | 0.0609 | 4.75E-5 |
| | P7 | 1959.247 | 1.09 | 0.295 | 0.0482 | 4.97E-5 |
| | P14 | 1931.380 | 1.51 | 0.407 | 0.0664 | 1.19E-4 |

from a constant offset and appear more erratic. Such variations are due to some modified absorption line data and are exemplified by the P10 line of the 7-6 vibrational transition located at 2177.99 $cm^{-1}$ which has actually decreased by about 50 percent despite the inclusion of the water vapor continuum. (3) Changes in absorption coefficients in the HF and CO emission region result principally from changes in the molecular absorption line parameters.

Laser emission frequencies identified with an asterisk in Table 7 have been used as input to the LASER program and charts of the four extinction coefficients identified in Eq. (1) have been included in Appendix B. The determination of which charts to include in Appendix B and which to omit was based on the following: (1) In view of the capability for the user to use the LASER program for his own purposes, it seemed unreasonable to include charts for all previously published laser frequencies, even though revisions can be made to all previously published results; (2) charts are included for several lines which the authors have found to be of great current interest; (3) charts are included for a few laser frequencies where previously published results are felt to be in gross error.

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# Appendix A

## The LASER Computer Program

A general flow chart for LASER is given in Figure A1 which shows the basic routines of the computer program. More detailed flow charts are given in Figures A2, A3, and A4 for the main program (LASER) and the subroutines ATMOS and CONT, respectively. The main program reads in the atmospheric models and all other data. The basic molecular absorption coefficient due to discrete absorption lines is performed in subroutine ATMOS. Subroutine CONT adds in the various sources of continuous extinction: Molecular scattering, molecular absorption continua, aerosol absorption and scattering effects. There are no flow charts provided for either the RDTAPE or VOIGT subroutines. The RDTAPE subroutine simply reads the AFGL Atmospheric Absorption Line Parameters Tape and places in storage the molecular absorption line data pertinent to the laser emission frequencies and atmospheric path defined as input. The VOIGT subroutine computes a combined Doppler-Lorentz line shape when the atmospheric pressure is between 10 mb and 0.1 mb. The VOIGT subroutine has been taken from the work of Young[15] where a complete description of the mathematics used in the computer routine can be obtained.

Following the computer flow charts, we have provided a complete listing of the LASER computer program, together with all required input data. If the user desires an extinction coefficient chart similar to those provided in Appendix B, he need only add a single card to the data deck corresponding to the READ statement at Line A 187 in the main program (PROGRAM LASER). This card must have

the frequency (in $cm^{-1}$) and the BOUND value (corresponding to the maximum frequency spread from an absorption line center that its contribution will be considered) according to the FORMAT (2F10.3). The following is an example of the input data required on this card to generate the laser extinction coefficient chart corresponding to the laser emission frequency, 924.975 $cm^{-1}$ in Appendix B:

***924.975****20.000

If the Bound value is not specified, a default option in the LASER program will set it equal to 20.00.

If the user of the LASER Program wishes to insert an atmospheric model that differs from the six models available as standard input, it is necessary to substitute his data (or model) for one of the standard models in the same format, with quantities provided in the same units as indicated in Table 5, and with the same number of atmospheric levels used to describe the model. The easiest way to insert an alternative model is to maintain consistency with the height structure indicated in the models of Table 5. That is, temperature, pressure, water vapor and ozone data should be inserted for the same 33 altitude levels defined in Table 5. Although a complete 33-level model should always be defined, it is appropriate to substitute data for any one or more levels in one of the models, in order to obtain results for a problem where a more limited set of atmospheric data is available. If the user intends to deviate further from the form of these models, it will be necessary to perform additional modifications to the computer program.

Due to the small variations in molecular scattering coefficients among the six standard atmospheric models, we have only provided these results for the U.S. Standard Atmosphere. If the user desires molecular scattering coefficient results for any other model, he need simply interchange the desired atmospheric model to the position of the sixth model.

A definition of all variables used in program LASER is contained in the computer listing. Copious comment cards have been used throughout in an effort to provide for the user the required detailed understanding of the physics and the flow of logic in the program.

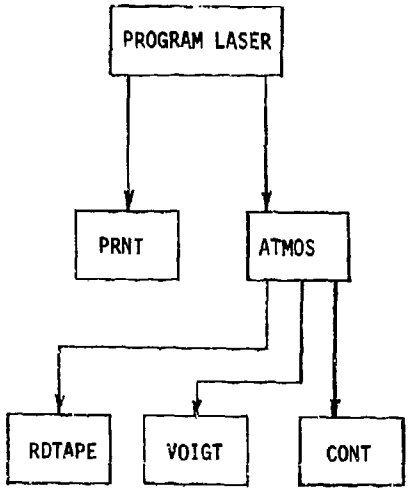


Figure A1. General Flow Chart for LASER Program

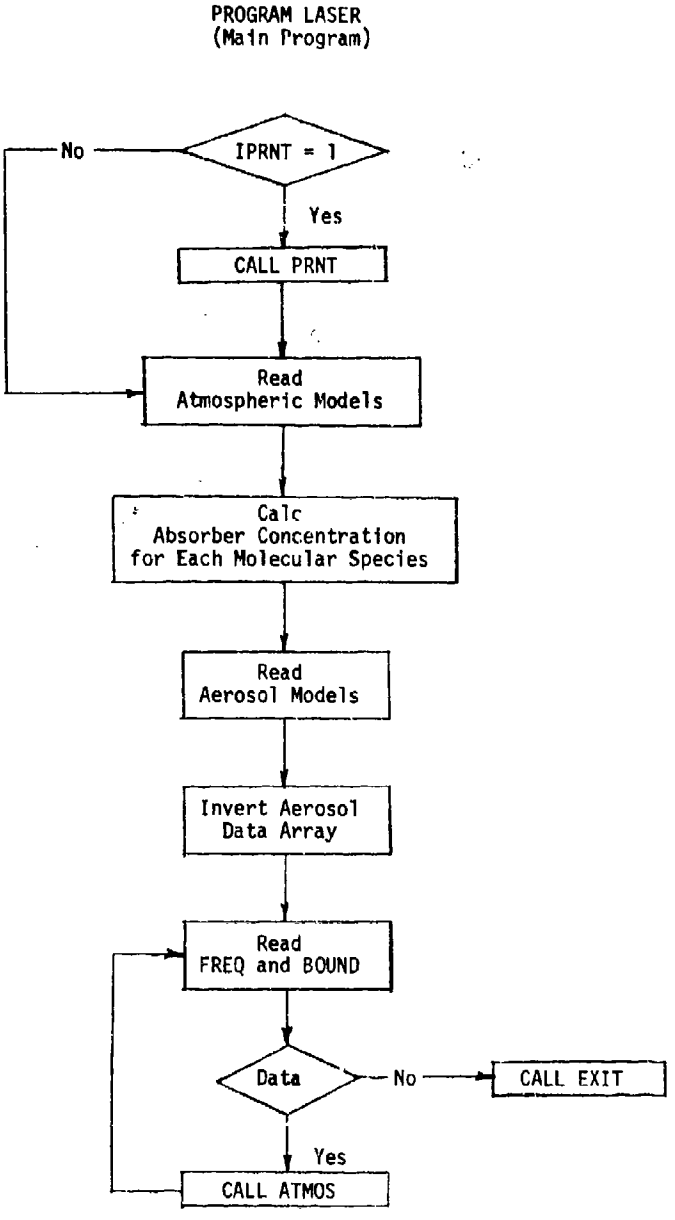


Figure A2. Detailed Flow Chart for LASER Program

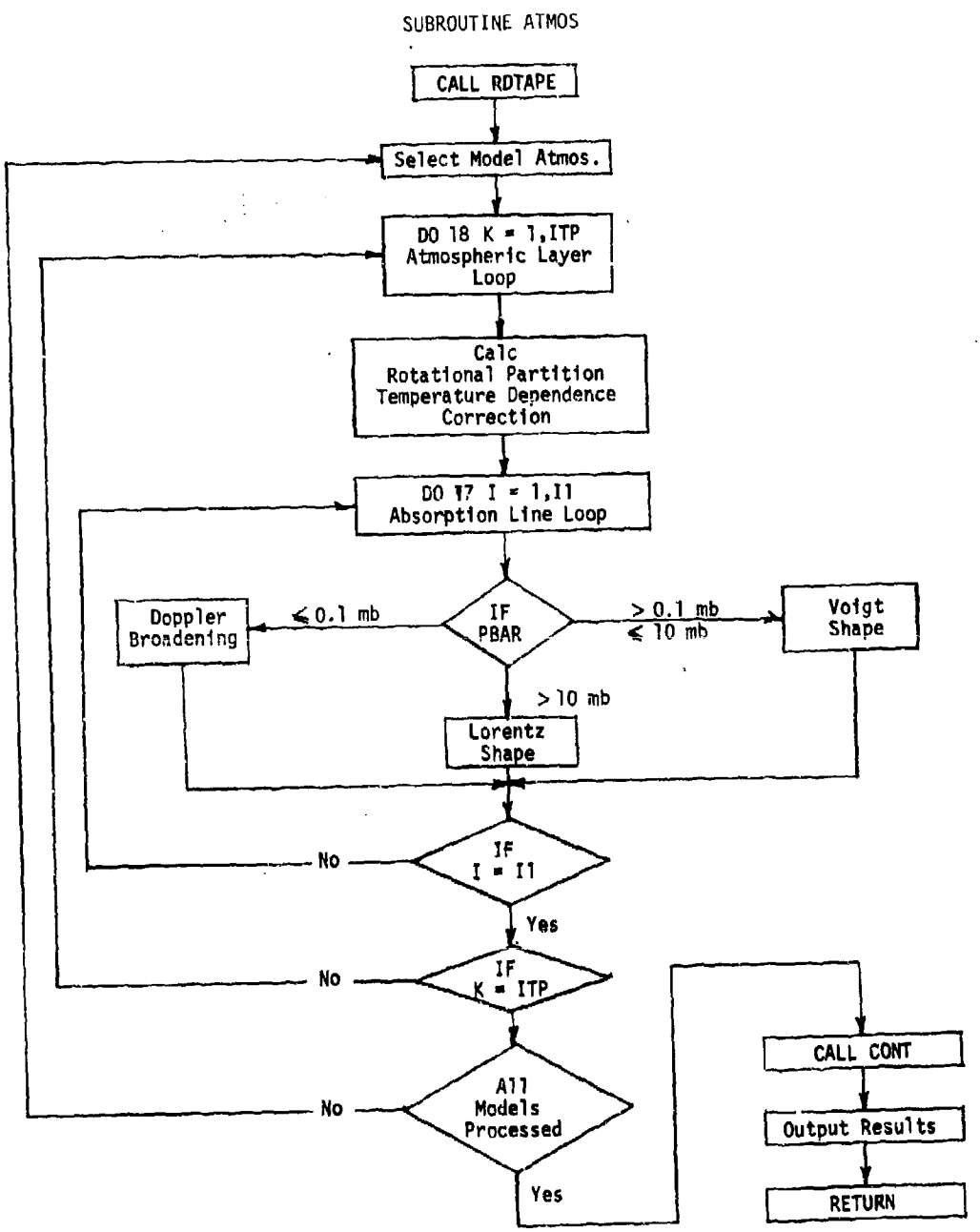


Figure A3. Detailed Flow Chart for Subroutine ATMOS

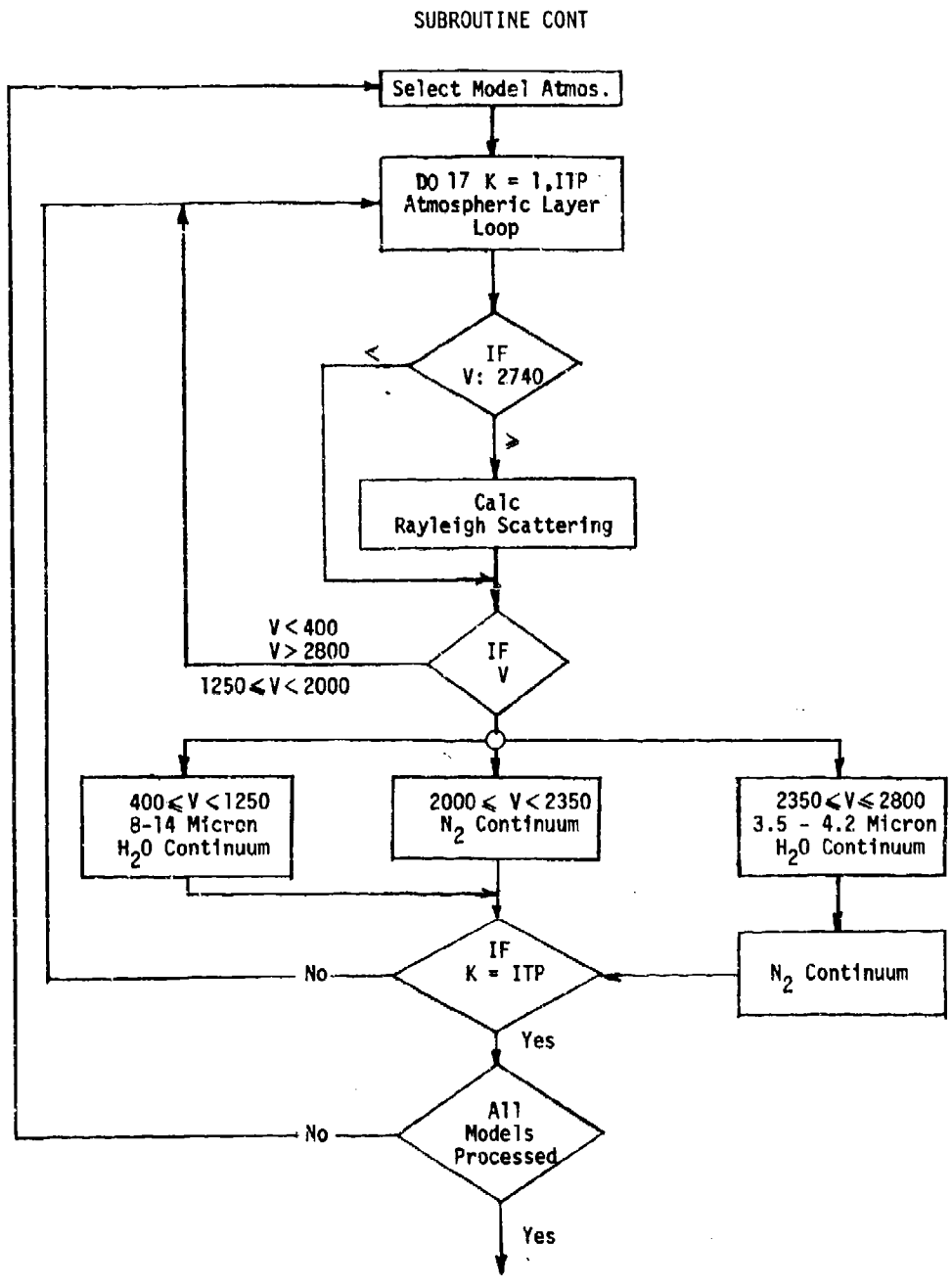


Figure A4. Detailed Flow Chart for CONT Subroutine

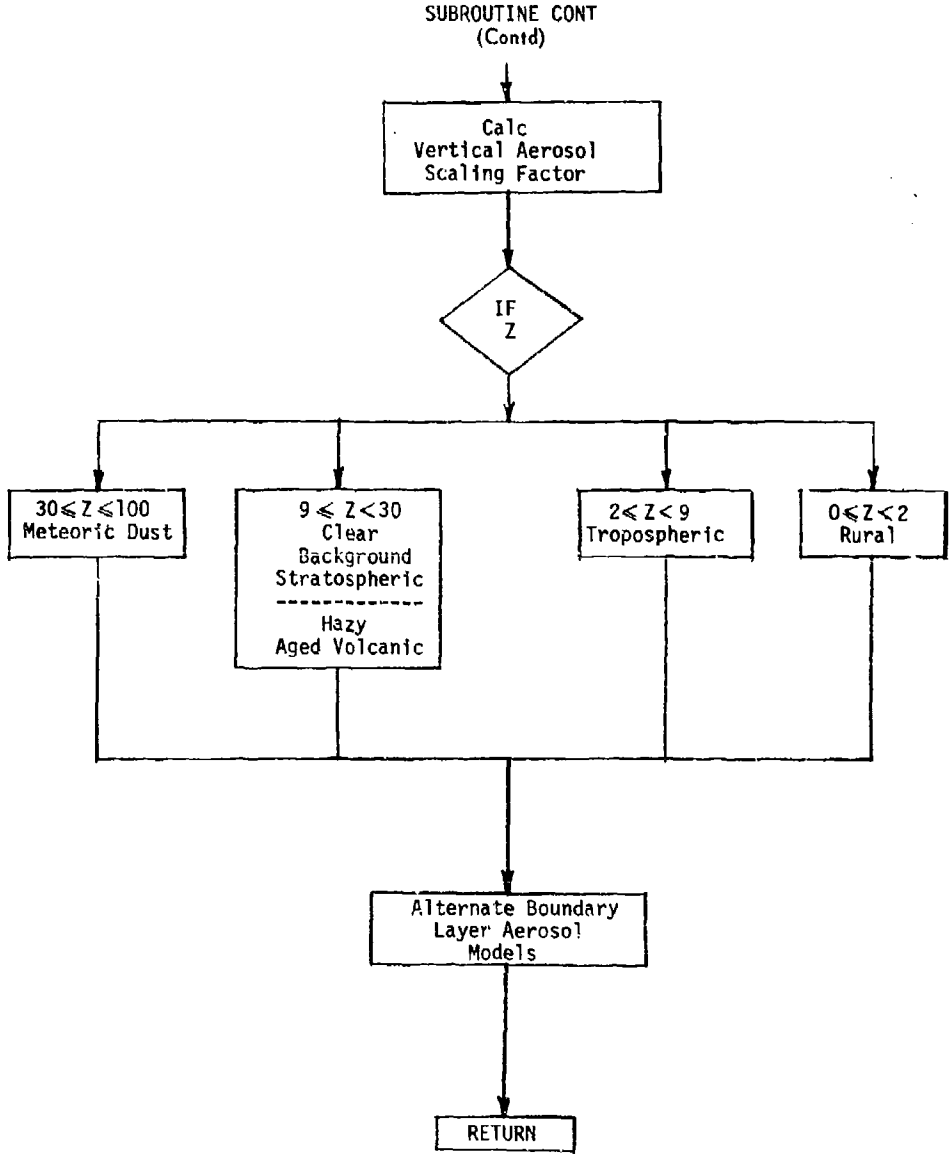


Figure A4. Detailed Flow Chart for CONT Subroutine (Contd)

```
      PROGRAM LASER(INPUT,OUTPUT,TAPE3)                                  A   1
C LASER CALCULATES ATMOSPHERIC TRANSMITTANCE THROUGH ATMOSPHERE WITH ITP  A   2
C LEVELS AND PRINTS OUT VALUES FROM LOWEST PRESSURE TO EACH LEVEL.        A   3
C                                                                         A   4
C     A         INPUT DATA FOR VOIGT SUBROUTINE                         A   5
C     AAB       AEROSOL ABSORPTION COEFFICIENT - INPUT DATA             A   6
C     ALFA0     LINE HALF WIDTH                                         A   7
C     AML       HEIGHT INCREMENT - INPUT DATA                           A   8
C     ARSMODL   AEROSOL MODEL - INPUT DATA                              A   9
C     ASC       AEROSOL SCATTERING COEFFICIENT - INPUT DATA             A  10
C     ATMODL    ATMOSPHERIC MODEL - INPUT DATA                          A  11
C     BOUND     LIMIT OUTSIDE OF WHICH LINE CONTRIBUTIONS ARE NOT       A  12
C               CONSIDERED - INPUT DATA                                 A  13
C     CAS       CLEAR AEROSOL SCATTERING COEFFICIENT (50 KM SEA LEVEL   A  14
C               VISIBILITY) - OUTPUT DATA                               A  15
C     CAY       MOLECULAR ABSORPTION COEFFICIENT - OUTPUT DATA          A  16
C     CHI       MODIFICATION TO THE LORENTZ LINE SHAPE FOR CO2          A  17
C               - INPUT DATA                                            A  18
C     CN2       NITROGEN CONTINUUM ABSORPTION COEFFICIENT - INPUT DATA  A  19
C     CON       WATER VAPOR CONTINUUM COEFFICIENT FOR 3.5-4.2 MICRONS   A  20
C               - INPUT DATA                                            A  21
C     DELTAZ    DIFFERENCE BETWEEN TWO ADJACENT LAYERS                  A  22
C     DNU       FREQUENCY INCREMENT ASSOCIATED WITH LORENTZ MODIFICATION A  23
C               - INPUT DATA                                            A  24
C     EPP       ENERGY OF LOWER STATE OF TRANSITION                     A  25
C     FA        AEROSOL MODEL FREQUENCY - INPUT DATA                    A  26
C     FKC       INITIAL FREQUENCY FOR THE 3.5-4.2 WATER VAPOR CONTINUUM A  27
C               - INPUT DATA                                            A  28
C     FN2       NITROGEN CONTINUUM ABSORPTION COEFFICIENT FREQUENCY     A  29
C               - INPUT DATA                                            A  30
C     GNU       LINE FREQUENCY                                          A  31
C     HAS       HAZY: AEROSOL SCATTERING COEFFICIENT (5 KM SEA LEVEL    A  32
C               VISIBILITY) - OUTPUT DATA                               A  33
C     HCONV     0.1*3.34E+22 MOLECULES/CM2                              A  34
C     HH        INPUT DATA FOR VOIGT SUBROUTINE                         A  35
C     HZ1       VERTICAL SCALING FACTOR FOR CLEAR AEROSOL MODEL         A  36
C               - INPUT DATA                                            A  37
C     HZ2       VERTICAL SCALING FACTOR FOR HAZY AEROSOL MODEL          A  38
C               - INPUT DATA                                            A  39
C     IPRNT     PRINT CONTROL FOR SUBROUTINE PRNT. IPRNT= 1, CALL PRNT  A  40
C     ITP       NUMBER OF ATMOSPHERIC LAYERS - INPUT DATA               A  41
C     JT        NUMBER OF ELEMENTS IN THE LORENTZ MODIFICATION FACTOR   A  42
C               - INPUT DATA                                            A  43
C     KSAM      NUMBER OF MODEL ATMOSPHERES - INPUT DATA                A  44
C     MOL       MOLECULE IDENTIFIER (1= H2O, 2= CO2, 3= O3, 4= N2O,     A  45
C               5= CO, 6= CH4, 7= O2)                                   A  46
C     NH        NUMBER OF ELEMENTS FOR THE VOIGT INPUT DATA HH AND XX   A  47
C     O3CON     CONVERSION FACTOR FROM GM/M**3 TO MOLECULES/CM**2       A  48
C     P         ATMOSPHERIC LEVEL PRESSURE - INPUT DATA                 A  49
C     S         ABSORPTION LINE INTENSITY                               A  50
C     SEC       SECANT ANGLE                                            A  51
C     T         ATMOSPHERIC LAYER TEMPERATURE - INPUT DATA              A  52
C     TA1       CLEAR: AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA     A  53
C     TA2       HAZY: AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA      A  54
C     TEMP1     TEMPORARY DATA STORAGE FOR AEROSOL VARIABLE FA          A  55
C     TEMP2     TEMPORARY DATA STORAGE FOR AEROSOL VARIABLE ASC         A  56
C     TEMP3     TEMPORARY DATA STORAGE FOR AEROSOL VARIABLE AAB         A  57
C     TM        RAYLEIGH (MOLECULAR) SCATTERING COEFFICIENT             A  58
C               - OUTPUT DATA                                           A  59
C     UNF       UNIFORMLY MIXED GAS CONSTANTS FOR: CO2, N2O, CO, CH4, O2 A  60
C     V         FREQUENCY AT WHICH THE EXTINCTION COEFFICIENT ARE BEING  A  61
C               CALCULATED - INPUT DATA                                 A  62
C     VTOP      UPPER FREQUENCY LIMIT FOR THE LINE CONTRIBUTIONS.       A  63
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C               VTOP= V+BOUND                                                   A  64
C     W         ABSORBER CONCENTRATION                                          A  65
C     WBAR      MEAN WATER VAPOR CONCENTRATION FOR A LAYER                      A  66
C     WG        SEA LEVEL VALUES OF MOLECULAR ABUNDANCES                        A  67
C     WH        WATER VAPOR CONCENTRATION AT A SPECIFIC LEVEL                   A  68
C     WH1       SCALE HEIGHT ASSOCIATED WITH WATER VAPOR                        A  69
C     WH3       SCALE HEIGHT ASSOCIATED WITH OZONE                              A  70
C     WO        OZONE CONCENTRATION AT A SPECIFIC LEVEL                         A  71
C     WO3       MEAN OZONE CONCENTRATION FOR A LAYER                            A  72
C     W1D       INTERMEDIATE QUANTITY ASSOCIATED WITH COMPUTING                 A  73
C               INTEGRATED WATER AMOUNT                                         A  74
C     W3D       INTERMEDIATE QUANTITY ASSOCIATED WITH COMPUTING                 A  75
C               INTEGRATED OZONE AMOUNT                                         A  76
C     XX        INPUT DATA FOR VOIGT SUBROUTINE                                 A  77
C     Z         ATMOSPHERIC HEIGHT (KM)                                         A  78
C                                                                               A  79
      COMMON GNU(1000),S(1000),ALFA0(1000),EPP(1000),HOL(1000)                  A  80
      COMMON Z(40),P(6,40),T(6,40),W(6,7,40),CAY(6,40),WG(6,7)                  A  81
      COMMON TM(6,40),TA1(4,40),TA2(4,40)                                       A  82
      COMMON FA(7,70),ASC(7,70),AAB(7,70),CAS(7,40),HAS(7,40)                   A  83
      COMMON /BLK1/ JT,ONU(20),CHI(20),AML(40)                                  A  84
      COMMON /BLK2/ FKC,CON(20),FN2(100),CN2(100),HZ1(40),HZ2(40)               A  85
      COMMON /BLK3/ NH,HH(10),XX(10),A(42)                                      A  86
      DIMENSION ATMODL(6,2), ARSMODL(7,4)                                       A  87
      DIMENSION UNF(7), WH(6,40), WO(6,40)                                      A  88
      DATA (UNF(M),M=1,7)/0.0,7.102E+21,0.0,5.918E+18,1.614E+18,3.443E+1        A  89
     19,4.519E+24/                                                              A  90
      DATA HCONV,O3CON/3.34E+21,1.255E+21/                                      A  91
      PRINT 16                                                                  A  92
      IPRNT=1                                                                   A  93
      IF (IPRNT.EQ.1) CALL PRNT                                                 A  94
      VTOP=0                                                                    A  95
      READ 17, ITP,SEC,KSAM                                                     A  96
      PRINT 18, ITP,SEC,KSAM                                                    A  97
      DO 1 I=1,6                                                                A  98
      READ 19, (WG(I,M),M=1,7)                                                  A  99
1     CONTINUE                                                                  A 100
      PRINT 20, ((WG(I,M),M=1,7),I=1,6)                                         A 101
C                                                                               A 102
C     K= 1  TROPICAL                                                            A 103
C     K= 2  MIDLATITUDE SUMMER                                                  A 104
C     K= 3  MIDLATITUDE WINTER                                                  A 105
C     K= 4  SUBARCTIC SUMMER                                                    A 106
C     K= 5  SUBARCTIC WINTER                                                    A 107
C     K= 6  U.S. STANDARD                                                       A 108
      DO 2 J=1,3                                                                A 109
      I2=2*J                                                                    A 110
      I1=I2-1                                                                   A 111
      READ 21, ((ATMODL(I,II),II=1,2),I=I1,I2)                                  A 112
      DO 2 L=1,ITP                                                              A 113
      K=ITP-L+1                                                                 A 114
      READ 22, Z(K),(P(I,K),T(I,K),WH(I,K),WO(I,K),I=I1,I2)                     A 115
2     CONTINUE                                                                  A 116
C                                                                               A 117
C     MOLECULAR DENSITIES ARE ASSUMED TO DECREASE EXPONENTIALLY                 A 118
C     BETWEEN CONSECUTIVES LEVELS.                                              A 119
C                                                                               A 120
      K1=ITP-1                                                                  A 121
      DO 6 I=1,6                                                                A 122
      DO 6 K=1,K1                                                               A 123
      WBAR=(WH(I,K)+WH(I,K+1))/2.0                                              A 124
      WO3=(WO(I,K)+WO(I,K+1))/2.0                                               A 125
      DELTAZ=Z(K)-Z(K+1)                                                        A 126
      W1D=WH(I,K)/WH(I,K+1)                                                     A 127
      W3D=WO(I,K)/WO(I,K+1)                                                     A 128
      WH1=-DELTAZ/ALOG(W1D)                                                     A 129
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      WH3=-DELTAZ/ALOG(W3D)                                              A 130
      IF (ABS(W1D-1.0D).LT.0.1) GO TO 3                                  A 131
      W(I,1,K)=WH1*HCONV*(WH(I,K+1)-WH(I,K))                             A 132
      GO TO 4                                                            A 133
3     W(I,1,K)=WBAR*HCONV*DELTAZ                                         A 134
4     IF (ABS(W3D-1.0D).LT.0.1) GO TO 5                                  A 135
      W(I,3,K)=WH3*O3CON*(WO(I,K+1)-WO(I,K))                             A 136
      GO TO 6                                                            A 137
5     W(I,3,K)=WO3*O3CON*DELTAZ                                          A 138
6     CONTINUE                                                           A 139
      DO 9 I=1,6                                                         A 140
      PRINT 23, (ATMODL(I,II),II=1,2)                                    A 141
C                                                                        A 142
C     THE MOLECULAR DENSITIES OF UNIFORMLY MIXED GASES IN A GIVEN LAYER  A 143
C     IS DIRECTLY RELATED TO THE PRESSURE INCREMENT BETWEEN              A 144
C     THE LAYER BOUNDARIES.                                              A 145
C                                                                        A 146
      DO 7 K=1,K1                                                        A 147
      DO 7 M=1,7                                                         A 148
      IF (M.EQ.1.OR.M.EQ.3) GO TO 7                                      A 149
      W(I,M,K)=((P(I,K+1)-P(I,K))/1013.0)*UNF(M)                         A 150
7     CONTINUE                                                           A 151
      DO 8 K=1,K1                                                        A 152
      PRINT 24, (Z(K),P(I,K),T(I,K),(W(I,M,K),M=1,7))                    A 153
8     CONTINUE                                                           A 154
      PRINT 24, Z(ITP),P(I,ITP),T(I,ITP)                                 A 155
9     CONTINUE                                                           A 156
      DO 10 I=1,7                                                        A 157
      READ 25, (ARSMODL(I,II),II=1,4)                                    A 158
      READ 26, (FA(I,J),ASC(I,J),AAB(I,J),J=1,61)                        A 159
10    CONTINUE                                                           A 160
C                                                                        A 161
C     FOR OUR PURPOSES THE AEROSOL EXTINCTION COEFFICIENT ARRAYS         A 162
C     ARE INVERTED.                                                      A 163
C                                                                        A 164
      DO 11 I=1,7                                                        A 165
      DO 11 J=1,30                                                       A 166
      L=61-J+1                                                           A 167
      TEMP1=FA(I,L)                                                      A 168
      TEMP2=ASC(I,L)                                                     A 169
      TEMP3=AAB(I,L)                                                     A 170
      FA(I,L)=FA(I,J)                                                    A 171
      ASC(I,L)=ASC(I,J)                                                  A 172
      AAB(I,L)=AAB(I,J)                                                  A 173
      FA(I,J)=TEMP1                                                      A 174
      ASC(I,J)=TEMP2                                                     A 175
      AAB(I,J)=TEMP3                                                     A 176
11    CONTINUE                                                           A 177
      DO 12 I=1,7                                                        A 178
      DO 12 J=1,61                                                       A 179
      FA(I,J)=1.0E+04/FA(I,J)                                            A 180
12    CONTINUE                                                           A 181
      PRINT 16                                                           A 182
      DO 13 I=1,7                                                        A 183
      PRINT 27, (ARSMODL(I,II),II=1,4)                                   A 184
      PRINT 28, (FA(I,J),ASC(I,J),AAB(I,J),J=1,61)                       A 185
13    CONTINUE                                                           A 186
14    READ 29, V,BOUND                                                   A 187
      IF (BOUND.LE.0.0) BOUND=20.0                                       A 188
      REWIND 3                                                           A 189
      IF (V.EQ.0) GO TO 15                                               A 190
      IF (V.LT.VTOP) REWIND 3                                            A 191
      CALL ATMOS (V,BOUND,VTOP,SEC,ITP,KSAM)                             A 192
      GO TO 14                                                           A 193
15    CONTINUE                                                           A 194
      CALL EXIT                                                          A 195
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C                                                                       A 196
16    FORMAT (1H1)                                                      A 197
17    FORMAT (I3,F7.3,I3)                                               A 198
18    FORMAT (/////6*X,*ITP=*I3/63X,*SEC=*F6.3/63X,*KSAM=*I3)           A 199
19    FORMAT (7E10.3)                                                   A 200
20    FORMAT (/////4AX,*SEA LEVEL VALUES OF MOLECULAR ABUNDANCES*/58X,*( A 201
     1MOLECULES/SQ CM/KM)*/(32X,7(1PE10.2)))                            A 202
21    FORMAT (2(A10,A8))                                                A 203
22    FORMAT (F6.1,2(F10.3,F6.1,2F10.1))                                A 204
23    FORMAT (1H1///58X,A10,A8//44X,*ALL QUANTITIES IN UNITS OF MOLECUL A 205
     1ES/SQ CM*/44X,*CONTAINED BETWEEN SUCCESIVE HEIGHT INCREMENTS.*/44X A 206
     2,*FIRST ROW IS FOR LAYER FROM 100 - 70 KM.*//13X,*HT*,3X,*PRESSURE A 207
     3*,3X,*TEMP*,5X,*WATER*,8X,*CARBON*,10X,*NITROUS*,7X,*CARBON*/12X,* A 208
     4(KM)*,4X,*(MB)*,6X,*(K)*,5X,*VAPOR*,7X,*DIOXIDE*,7X,*OZONE*,8X,*OX A 209
     5IDE*,7X,*MONOXIDE*,5X,*METHANE*,7X,*OXYGEN*/)                     A 210
24    FORMAT (11X,0PF5.1,0PF10.3,0PF7.1,7(1PE13.5))                     A 211
25    FORMAT (4A6)                                                      A 212
26    FORMAT (3(F8.2,2F7.5))                                            A 213
27    FORMAT (////56X,4A6//7X,4(5X,*FREQUENCY*,3X,*SCAT*,5X,*ABS*)/7X,4( A 214
     17X,*(CM-1)*,2(4X,*COEF*))/)                                       A 215
28    FORMAT ((9X,4(F13.3,2F8.5)))                                      A 216
29    FORMAT (2F10.3)                                                   A 217
      END                                                               A 218-
      SUBROUTINE ATMOS (V,BOUND,VTOP,SEC,ITP,KSAM)                      B   1
C     AAB       AEROSOL ABSORPTION COEFFICIENT - INPUT DATA             B   2
C     ABSCLT    MOLECULAR ABSORPTION COEFFICIENT                        B   3
C     ALFAD     LINE HALF WIDTH                                         B   4
C     ALPHAD    DOPPLER HALF-WIDTH                                      B   5
C     ALPHAL    LORENTZ HALF-WIDTH                                      B   6
C     AML       HEIGHT INCREMENT - INPUT DATA                           B   7
C     ARGD      INTERMEDIATE QUANTITY ASSOCIATED WITH DOPPLER BROADENING B   8
C     ASC       AEROSOL SCATTERING COEFFICIENT - INPUT DATA             B   9
C     BOUND     LIMIT OUTSIDE OF WHICH LINE CONTRIBUTIONS ARE NOT       B  10
C               CONSIDERED - INPUT DATA                                 B  11
C     C         VELOCITY OF LIGHT                                       B  12
C     CA        HALF-WIDTH TEMPERATURE CORRECTION FACTOR                B  13
C     CAS       CLEAR AEROSOL SCATTERING COEFFICIENT (50 KM SEA LEVEL   B  14
C               VISIBILITY) - OUTPUT DATA                               B  15
C     CAY       MOLECULAR ABSORPTION COEFFICIENT - OUTPUT DATA          B  16
C     CHI       MODIFICATION TO THE LORENTZ LINE SHAPE FOR CO2          B  17
C               - INPUT DATA                                            B  18
C     CONST     (R*1.0E-03)/(A*1.0E+05), WHERE R IS GAS CONSTANT AND A  B  19
C               IS AVOGARDO'S NUMBER                                    B  20
C     CS1       BOLTZMANN'S TEMPERATURE CORRECTION FACTOR               B  21
C     CS2       PARTITION FUNCTION TEMPERATURE CORRECTION               B  22
C     C5        2 * BOLTZMANN'S CONSTANT * AVOGARDO'S NUMBER            B  23
C     C6        1/PI**0.5                                               B  24
C     DEL       HEIGHT INCREMENT BETWEEN LAYERS                         B  25
C     DNU       FREQUENCY INCREMENT ASSOCIATED WITH LORENTZ MODIFICATION B  26
C               - INPUT DATA                                            B  27
C     EPP       ENERGY OF LOWER STATE OF TRANSITION                     B  28
C     GNU       LINE FREQUENCY                                          B  29
C     H         ATMOSPHERIC HEIGHT (KM)                                 B  30
C     HAS       HAZY: AEROSOL SCATTERING COEFFICIENT (5 KM SEA LEVEL    B  31
C               VISIBILITY) - OUTPUT DATA                               B  32
C     IK1       ATMOSPHERIC MODEL INDEX                                 B  33
C     IPRNT     PRINT CONTROL                                           B  34
C     I1        NUMBER OF ABSORPTION LINES                              B  35
C     ITP       NUMBER OF ATMOSPHERIC LAYERS - INPUT DATA               B  36
C     JT        NUMBER OF ELEMENTS IN THE LORENTZ MODIFICATION FACTOR   B  37
C               - INPUT DATA                                            B  38
C     KSAM      NUMBER OF MODEL ATMOSPHERES - INPUT DATA                B  39
C     M         MOLECULAR SPECIE INDEX NUMBER                           B  40
C     MOL       MOLECULE IDENTIFIER (1= H2O, 2= CO2, 3= O3, 4= N2O,     B  41
C               5= CO, 6= CH4, 7= O2)                                   B  42
C     P         ATMOSPHERIC LEVEL PRESSURE - INPUT DATA                 B  43
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C     PBAR       AVERAGE LAYER PRESSURE                                    B  44
C     PEFF       EFFECTIVE PRESSURE (INCLUDES WATER VAPOR BROADENING       B  45
C                FACTOR)                                                   B  46
C     PH2O       WATER VAPOR PRESSURE                                      B  47
C     PI         RATIO OF CIRCUMFERENCE OF A CIRCLE TO ITS DIAMETER        B  48
C     RATIO      INTERMEDIATE QUANTITY ASSOCIATED WITH LORENTZ LINE        B  49
C                MODIFICATION                                              B  50
C     S          ABSORPTION LINE INTENSITY                                 B  51
C     SEC        SECANT ANGLE                                              B  52
C     ST         TEMPERATURE CORRECTED LINE INTENSITY                      B  53
C     T          ATMOSPHERIC LAYER TEMPERATURE - INPUT DATA                B  54
C     TA1        CLEAR: AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA       B  55
C     TA2        HAZY: AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA        B  56
C     TBAR       AVERAGE LAYER TEMPERATURE                                 B  57
C     TEMP0      296 (K)                                                   B  58
C     TM         RAYLEIGH (MOLECULAR) SCATTERING COEFFICIENT               B  59
C                - OUTPUT DATA                                             B  60
C     V          FREQUENCY AT WHICH THE EXTINCTION COEFFICIENTS ARE BEING  B  61
C                CALCULATED - INPUT DATA                                   B  62
C     VBOT       LOWER FREQUENCY LIMIT FOR THE LINE CONTRIBUTIONS.         B  63
C                VBOT= V-BOUND                                             B  64
C     VTOP       UPPER FREQUENCY LIMIT FOR THE LINE CONTRIBUTIONS.         B  65
C                VTOP= V+BOUND                                             B  66
C     VXY        VOIGT LINE SHAPE VARIABLE                                 B  67
C     W          ABSORBER CONCENTRATION                                    B  68
C     WG         SEA LEVEL VALUES OF MOLECULAR ABUNDANCES                  B  69
C     WTMOL      MOLECULAR WEIGHT                                          B  70
C     WV         WAVELENGTH CORRESPONDING TO FREQUENCY, V                  B  71
C     X          VOIGT LINE SHAPE VARIABLE                                 B  72
C     X1         LORENTZ LINE MODIFICATION VARIABLE                        B  73
C     Y          VOIGT LINE SHAPE VARIABLE                                 B  74
C     Z          ABSOLUTE DISTANCE FROM THE LINE CENTER FREQUENCY V        B  75
      COMMON GNU(1000),S(1000),ALFA0(1000),EPP(1000),NOL(1000)             B  76
      COMMON H(40),P(6,40),T(6,40),W(6,7,40),CAY(6,40),WG(6,7)             B  77
      COMMON TM(6,40),TA1(4,40),TA2(4,40)                                  B  78
      COMMON FA(7,70),ASC(7,70),AAB(7,70),CAS(7,40),HAS(7,40)              B  79
      COMMON /BLK1/ JT,DNU(20),CHI(20),AML(40)                             B  80
      DIMENSION WTMOL(7), CS2(7), ALPHA0(7), DEL(7)                        B  81
      DIMENSION ST(1000)                                                   B  82
      DATA C,C5,C6,PI/2.99791E+10,1.6629E+08,0.56419,3.1415927/            B  83
      DATA (WTMOL(I),I=1,7)/18.0,44.0,46.0,44.0,28.0,16.0,32.0/            B  84
      DATA (DEL(I),I=1,7)/30.0,20.0,5*5.0/                                 B  85
      DATA CONST/1.380258E-24/                                             B  86
C                                                                          B  87
C     CONST= (R*1.0E-03)/(A*1.0E+05)                                       B  88
C          = (8.3144E+07*1.0E-03)/(6.0238E+23*1.0E+05)                     B  89
C                                                                          B  90
      IPRNT=0                                                              B  91
      IK1=0                                                                B  92
      VBOT=V-BOUND                                                         B  93
      VTOP=V+BOUND                                                         B  94
      CALL RDTAPE (VBOT,VTOP,I1,ITP,SEC)                                   B  95
C                                                                          B  96
C     DO 16 IS  THE MAJOR COMPUTATIONAL LOOP ON ATMOSPHERIC LAYER          B  97
C     WITHIN WHICH MONOCHROMATIC MOLECULAR ABSORPTION COEFFICIENTS         B  98
C     ARE COMPUTED.                                                        B  99
C                                                                          B 100
1     IK1=IK1+1                                                            B 101
      TEMP0=296.0                                                          B 102
      DO 16 K=1,ITP                                                        B 103
      IF (K.EQ.ITP) GO TO 2                                                B 104
      PBAR=(P(IK1,K)+P(IK1,K+1))/2.0                                       B 105
      TBAR=(T(IK1,K)+T(IK1,K+1))/2.0                                       B 106
      PH2O=CONST*TBAR*W(IK1,1,K)/ABS(H(K)-H(K+1))                          B 107
      GO TO 3                                                              B 108
2     PBAR=P(IK1,ITP)                                                      B 109
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      TBAR=T(IK1,ITP)                                                   B 110
      PH2O=CONST*TBAR*WG(IK1,1)                                         B 111
3     CS1=(TEMP0-TBAR)/(TEMP0*TBAR*0.6951)                              B 112
      CA=SQRT(296.0/TBAR)                                               B 113
C                                                                       B 114
C     DETERMINE CORRECT TEMPERATURE DEPENDENCE OF ROTATIONAL PARTITION  B 115
C     FUNCTION                                                          B 116
C                                                                       B 117
      DO 6 M=1,7                                                        B 118
      GO TO (4,5,4,5,5,4,5), M                                          B 119
4     CS2(M)=(TEMP0/TBAR)**1.5                                          B 120
      GO TO 6                                                           B 121
5     CS2(M)=TEMP0/TBAR                                                 B 122
6     ALPHAD(M)=SQRT(CS*TBAR/WTMOL(M))*V/C                              B 123
      DO 7 I=1,I1                                                       B 124
      M=MOL(I)                                                          B 125
7     ST(I)=S(I)*CS2(M)*EXP(-EPP(I)*CS1)                                B 126
      CAY(IK1,K)=0.0                                                    B 127
C                                                                       B 128
C     DO 17 LOOP CYCLES THRU ALL ABSORPTION LINES READ FROM HITRAN TAPE B 129
C     AND ADDS THEIR CONTRIBUTIONS TO THE ABSORPTION COEFFICIENT        B 130
C     AT THE FREQUENCY, V.                                              B 131
C                                                                       B 132
      DO 17 I=1,I1                                                      B 133
      M=MOL(I)                                                          B 134
      PEFF=PBAR                                                         B 135
      IF (M.EQ.1) PEFF=PBAR+4.0*PH2O                                    B 136
      ALPHAL=ALFA0(I)*PEFF*CA/1013.0                                    B 137
      Z=ABS(V-GNU(I))                                                   B 138
      IF (M.NE.2) X1=1.0                                                B 139
      IF (M.NE.2) GO TO 10                                              B 140
      X1=0.0                                                            B 141
      JT1=JT-1                                                          B 142
      DO 9 L=1,JT1                                                      B 143
      IF (Z.GE.DNU(L).AND.Z.LE.DNU(L+1)) GO TO 8                        B 144
      GO TO 9                                                           B 145
8     RATIO=(CHI(L+1)-CHI(L))/(DNU(L+1)-DNU(L))                         B 146
      X1=RATIO*(Z-DNU(L))+CHI(L)                                        B 147
      GO TO 11                                                          B 148
9     CONTINUE                                                          B 149
10    CONTINUE                                                          B 150
C                                                                       B 151
C     IF PBAR .LE. 0.1 MB, PURE DOPPLER BROADENING APPLIES.             B 152
C                                                                       B 153
11    IF (PBAR-0.10) 12,12,13                                           B 154
12    ARGD=Z/ALPHAD(M)                                                  B 155
      IF (ARGD.GT.10.0) GO TO 17                                        B 156
      ABSCLI=(CS/ALPHAD(M))*ST(I)*EXP(-(ARGD)**2)*W(IK1,M,K)            B 157
      CAY(IK1,K)=CAY(IK1,K)+ABSCLI                                      B 158
      GO TO 17                                                          B 159
C                                                                       B 160
C     IF PBAR IS BETWEEN 0.1 AND 10 MB, VOIGT SHAPE APPLIES.            B 161
C                                                                       B 162
13    IF (PBAR-10.0) 14,14,15                                           B 163
14    X=Z/ALPHAD(M)                                                     B 164
      Y=ALPHAL/ALPHAD(M)                                                B 165
      VXY=VOIGT(X,Y)                                                    B 166
      ABSCLI=VXY*ST(I)*0.56419/ALPHAD(M)*W(IK1,M,K)                     B 167
      CAY(IK1,K)=CAY(IK1,K)+ABSCLI                                      B 168
      IF (VXY.LT.0.0) PRINT 20, X,Y,VXY                                 B 169
      GO TO 17                                                          B 170
C                                                                       B 171
C     IF PBAR .GT. 10 MB, LORENTZ SHAPE APPLIES.                        B 172
C                                                                       B 173
15    IF (K.EQ.ITP) GO TO 16                                            B 174
      CAY(IK1,K)=ST(I)*ALPHAL/(PI*(Z*Z+ALPHAL*ALPHAL))*W(IK1,M,K)*X1+CAY B 175
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     1(IK1,K)                                                                  B 176
      GO TO 17                                                                 B 177
16    CAY(IK1,K)=ST(I)*ALPHAL*WG(IK1,M)/(PI*(Z*Z+ALPHAL*ALPHAL))*X1+CAY(       B 178
     1IK1,K)                                                                   B 179
17    CONTINUE                                                                 B 180
18    CONTINUE                                                                 B 181
      IF (IPRNT.EQ.1) PRINT 25, V                                              B 182
      IF (IK1.GE.KSAM) GO TO 19                                                B 183
      GO TO 1                                                                  B 184
19    CALL CONT (V,ITP,KSAM,SEC)                                               B 185
C                                                                              B 186
C     EXTINCTION COEFFICIENT FOR HIGH ATMOSPHERIC LAYERS MUST BE               B 187
C     DIVIDED BY LAYER THICKNESS SO THAT ALL RESULTS ARE IN                    B 188
C     UNITS, KM**-1.                                                           B 189
C                                                                              B 190
      DO 20 I=1,KSAM                                                           B 191
      DO 20 K=1,7                                                              B 192
      CAY(I,K)=CAY(1,K)/DEL(K)                                                 B 193
20    CONTINUE                                                                 B 194
      WV=10000.0/V                                                             B 195
      PRINT 26, WV,V                                                           B 196
      DO 23 KO=1,ITP                                                           B 197
      K=ITP-KO+1                                                               B 198
      DO 21 I=1,KSAM                                                           B 199
      IF (CAY(I,K).LT.1.0E-6) CAY(I,K)=0.                                      B 200
      IF (TM(I,K).LT.1.0E-6) TM(I,K)=0.                                        B 201
21    CONTINUE                                                                 B 202
      DO 22 I=1,4                                                              B 203
      IF (TA1(I,K).LT.1.0E-06) TA1(I,K)=0.0                                    B 204
      IF (CAS(I,K).LT.1.0E-06) CAS(I,K)=0.0                                    B 205
      IF (TA2(I,K).LT.1.0E-06) TA2(I,K)=0.0                                    B 206
      IF (HAS(I,K).LT.1.0E-06) HAS(I,K)=0.0                                    B 207
22    CONTINUE                                                                 B 208
      PRINT 27, AML(K),CAY(6,K),TM(6,K),(CAY(JM,K),JM=1,5),TA1(1,K),CAS(       B 209
     11,K),TA2(1,K),HAS(1,K)                                                   B 210
23    CONTINUE                                                                 B 211
      PRINT 28                                                                 B 212
      PRINT 29, TA2(4,ITP),HAS(4,ITP)                                          B 213
      PRINT 30, TA1(3,ITP),CAS(3,ITP),TA2(3,ITP),HAS(3,ITP)                    B 214
      PRINT 31, TA1(2,ITP),CAS(2,ITP)                                          B 215
      PRINT 32, V,BOUND                                                        B 216
      PRINT 33, I1,GNU(1),GNU(I1)                                              B 217
      I1=0                                                                     B 218
      RETURN                                                                   B 219
C                                                                              B 220
24    FORMAT (* X,Y,VX1,*,3E15.6)                                              B 221
25    FORMAT (4H V =F11.4)                                                     B 222
26    FORMAT (1H1,39X,*WAVELENGTH = *,F15.6,* MICROMETERS*/40X,* FREQUEN       B 223
     1CY = *,F15.3,* WAVENUMBER*///19X,*U.S.*,16X,2(5X,*MIDLAT*),1X,2(2X      B 224
     2,*SUBARCTIC*),18X,*AEROSOL*/17X,*STANDARD*,7X,*TROPICAL*,4X,*SUMME      B 225
     3R*,5X,*WINTER*,5X,*SUMMER*,5X,*WINTER*,10X,*CLEAR*,16X,*HAZY*//)        B 226
27    FORMAT (A10,1PE10.2,1PE9.2,5(1PE11.2),2(1PE11.2,1PE9.2))                 B 227
28    FORMAT (///43X,*ALTERNATE BOUNDRY LAYER AEROSOL MODELS*//49X,*CLEA       B 228
     1R*,17X,*HAZY*//)                                                         B 229
29    FORMAT (29X,*URBAN        *,2(9H ********),3X,2(1PE9.2)/)                B 230
30    FORMAT (29X,*MARITIME     *,2(1PE9.2),3X,2(1PE9.2)/)                     B 231
31    FORMAT (29X,*TROPOSPHERIC*,2(1PE9.2),3X,2(9H ********)/)                 B 232
32    FORMAT (///29X,*V=*F12.3,* BOUND= *F12.3)                                B 233
33    FORMAT (29X,*I1= *,I5,3X,*GNU(1)= *,F10.3,3X,*GNU(I1)= *,F10.3)          B 234
      END                                                                      B 235-
      SUBROUTINE ROTAPE (V1,V2,I1,ITP,SEC)                                     C   1
C     ALFAO     LINE HALF WIDTH                                              C   2
C     ALP       LINE HALF-WIDTH TIMES THE AVERAGE ATMOSPHERIC PRESSURE       C   3
C     EPP       ENERGY OF LOWER STATE OF TRANSITION                          C   4
C     GNU       LINE FREQUENCY                                               C   5
C     IEOF      TAPE/DISK END OF FILE COUNT                                  C   6
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C     ITI       MOLECULAR LINE SPECIE IDENTIFICATION TAPE/DISK              C   7
C               - INPUT DATA                                                C   8
C     ITP       NUMBER OF ATMOSPHERIC LAYERS - INPUT DATA                   C   9
C     I1        NUMBER OF ABSORPTION LINES                                  C  10
C     MOL       MOLECULE IDENTIFIER (1= H2O, 2= CO2, 3= O3, 4= N2O,         C  11
C               5= CO, 6= CH4, 7= O2)                                       C  12
C     NIREC     NUMBER OF LINES PER RECORD                                  C  13
C     P         ATMOSPHERIC LEVEL PRESSURE - INPUT DATA                     C  14
C     PATH      OPTICAL DEPTH AT LINE CENTER FOR 1 - KM SEA LEVEL PATH      C  15
C     S         ABSORPTION LINE INTENSITY                                   C  16
C     SEC       SECANT ANGLE                                                C  17
C     TI        ABSORPTION LINE DATA TAPE/DISK - INPUT DATA                 C  18
C     TMAX      MAXIMUM FREQUENCY OF A TAPE/DISK RECORD                     C  19
C     TMIN      MINIMUM FREQUENCY OF A TAPE/DISK RECORD                     C  20
C     TTM       INTERMEDIATE FREQUENCY STORAGE VARIABLE                     C  21
C     V         FREQUENCY AT WHICH THE EXTINCTION COEFFICIENTS ARE BEING     C  22
C               CALCULATED - INPUT DATA                                     C  23
C     VREC      INTERMEDIATE MAXIMUM FREQUENCY STORAGE VARIABLE             C  24
C     VRUN      INTERMEDIATE FREQUENCY STORAGE VARIABLE                     C  25
C     V1        LOWER FREQUENCY LIMIT FOR THE LINE CONTRIBUTIONS.           C  26
C               V80T= V-BOUND                                               C  27
C     V2        UPPER FREQUENCY LIMIT FOR THE LINE CONTRIBUTIONS.           C  28
C               VTOP= V+BOUND                                               C  29
C     WG        SEALEVEL VALUES OF MOLECULAR ABUNDANCES                     C  30
C     WING      LINE WING CONTRIBUTION TO ABSOLUTE COEFFICIENT (USED FOR     C  31
C               REJECTING WEAK LINES)                                       C  32
C     Z         ABSOLUTE DISTANCE FROM THE LINE CENTER FREQUENCY V          C  33
      COMMON GNU(1000),S(1000),ALFA0(1000),EPP(1000),MOL(1000)              C  34
      COMMON H(40),P(6,40),T(6,40),W(6,7,40),CAY(6,40),WG(6,7)              C  35
      COMMON TM(6,40),TA1(4,40),TA2(4,40)                                   C  36
      COMMON FA(7,70),ASC(7,70),AAB(7,70),CAS(7,40),HAS(7,40)               C  37
      DIMENSION TI(250,12), ITI(250)                                        C  38
C     PREPARE TO READ TAPE                                                  C  39
      TTM=0.                                                                C  40
      IEOF=0                                                                C  41
      V=(V1+V2)/2.                                                          C  42
      J=1                                                                   C  43
1     READ (3) TMIN,TMAX,NIREC,((TI(I,K),K=1,12),ITI(I),I=1,NIREC)          C  44
      IF (EOF(3)) 2,3                                                       C  45
2     IEOF=IEOF+1                                                           C  46
      IF (IEOF.GT.50) GO TO 11                                              C  47
      GO TO 1                                                               C  48
3     VREC=TMAX                                                             C  49
      IF (TTM.GT.TMIN) GO TO 1                                              C  50
      TTM=TMAX                                                              C  51
      IEOF=0                                                                C  52
      IF (VREC-V1) 1,4,4                                                    C  53
4     DO 5 I=1,NIREC                                                        C  54
      VRUN=TI(I,1)                                                          C  55
      IF (VRUN.GE.V1) GO TO 6                                               C  56
5     CONTINUE                                                              C  57
6     DO 9 N=I,NIREC                                                        C  58
      VRUN=TI(N,1)                                                          C  59
      IF (VRUN.GT.V2) GO TO 11                                              C  60
      M=ITI(N)                                                              C  61
      GNU(J)=TI(N,1)                                                        C  62
      S(J)=TI(N,2)                                                          C  63
      ALFA0(J)=TI(N,3)                                                      C  64
      EPP(J)=TI(N,4)                                                        C  65
      MOL(J)=ITI(N)                                                         C  66
      IF (ALFA0(J).GT.0.0001) GO TO 8                                       C  67
      PRINT 12, ALFA0(J),GNU(J)                                             C  68
      STOP 1                                                                C  69
      ALP=ALFA0(J)*(P(1,1)+P(1,ITP))/2026.0                                 C  70
      PATH=S(J)*WG(1,M)*SEC/(3.1415927*ALP)                                 C  71
      IF (PATH.LT.0.0001) GO TO 9                                           C  72
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      Z=ABS(V-GNU(J))                                                    C  73
      WING=1.0                                                           C  74
      IF (Z.GT.1.0) WING=S(J)*WG(1,M)*ALP*SEC/(3.1415927*Z**2)           C  75
      IF (WING.LT.1.0E-5) GO TO 9                                        C  76
      J=J+1                                                              C  77
      IF (J.GT.1000) GO TO 10                                            C  78
9     CONTINUE                                                           C  79
      IF (VREC-V2) 1,11,11                                               C  80
10    PRINT 13                                                           C  81
11    I1=J-1                                                             C  82
      RETURN                                                             C  83
C                                                                        C  84
12    FORMAT (////30X,12H***** ALFA0=E12.4,3X,7HAT GNU=F10.3,6H *****)   C  85
13    FORMAT (*  DIMENSION EXCEEDED *)                                   C  86
      END                                                                C  87-
      SUBROUTINE CONT (V,ITP,KSAM,SEC)                                   D   1
C     AAB       AEROSOL ABSORPTION COEFFICIENT - INPUT DATA              D   2
C     ABSOR     8 - 14 MICRON CONTINUUM ABSORPTION COEFFICIENT           D   3
C     AKCL      CLEAR AEROSOL ABSORPTION COEFFICIENT INTERPOLATED AT     D   4
C               FREQUENCY V                                              D   5
C     AKHZ      HAZY AEROSOL ABSORPTION COEFFICIENT INTERPOLATED AT      D   6
C               FREQUENCY V                                              D   7
C     ASC       AEROSOL SCATTERING COEFFICIENT - INPUT DATA              D   8
C     ASHZ      HAZY AEROSOL SCATTERING COEFFICIENT INTERPOLATED AT      D   9
C               FREQUENCY V                                              D  10
C     CAS       CLEAR AEROSOL SCATTERING COEFFICIENT (50 KM SEA LEVEL    D  11
C               VISIBILITY) - OUTPUT DATA                                D  12
C     CAY       MOLECULAR ABSORPTION COEFFICIENT - OUTPUT DATA           D  13
C     CCONT     INTERPOLATED ABSORPTION COEFFICIENT FROM THE NITROGEN    D  14
C               DATA TABLE                                               D  15
C     CC1       273/1013                                                 D  16
C     CNCS      NITROGEN-BROADENED WATER VAPOR CONTINUUM ABSORPTION      D  17
C               COEFFICIENT                                              D  18
C     CN2       NITROGEN CONTINUUM ABSORPTION COEFFICIENT - INPUT DATA   D  19
C     CON       WATER VAPOR CONTINUUM COEFFICIENT FOR 3.5-4.2 MICRONS    D  20
C               - INPUT DATA                                             D  21
C     DELN2     INTERMEDIATE QUANTITY RELATED TO THE NITROGEN CONTINUUM   D  22
C     DELP      PRESSURE DIFFERENCE BETWEEN ATMOSPHERIC LEVELS           D  23
C     EVH1      CLEAR VERTICAL SCALING FACTOR                            D  24
C     EVH2      HAZY VERTICAL SCALING FACTOR                             D  25
C     EVN       DENSITY FACTOR FOR RAYLEIGH SCATTERING COEFFICIENT       D  26
C     FA        AEROSOL MODEL FREQUENCY - INPUT DATA                     D  27
C     FAC       INTERMEDIATE INTERPOLATING DATA FOR THE AEROSOL          D  28
C               FREQUENCY DATA                                           D  29
C     FN2       NITROGEN CONTINUUM ABSORPTION COEFFICIENT FREQUENCY      D  30
C               - INPUT DATA                                             D  31
C     HAS       HAZY AEROSOL SCATTERING COEFFICIENT (5 KM SEA LEVEL      D  32
C               VISIBILITY) - OUTPUT DATA                                D  33
C     HA1       INTERMEDIATE VERTICAL SCALING DATA FOR CLEAR AEROSOL     D  34
C               MODEL                                                    D  35
C     HA2       INTERMEDIATE VERTICAL SCALING DATA FOR HAZY AEROSOL      D  36
C               MODEL                                                    D  37
C     HM        INTERMEDIATE MOLECULAR SCATTERING PARAMETER              D  38
C     HZ1       VERTICAL SCALING FACTOR FOR CLEAR AEROSOL MODEL          D  39
C               - INPUT DATA                                             D  40
C     HZ2       VERTICAL SCALING FACTOR FOR HAZY AEROSOL MODEL           D  41
C               - INPUT DATA                                             D  42
C     H2OLAY    WATER VAPOR CONCENTRATION                                D  43
C     IPRNT     PRINT CONTROL PARAMETER                                  D  44
C     ITP       NUMBER OF ATMOSPHERIC LAYERS - INPUT DATA                D  45
C     KSAM      NUMBER OF MODEL ATMOSPHERES - INPUT DATA                 D  46
C     LC        CLEAR AEROSOL MODEL INDEX                                D  47
C     LH        HAZY AEROSOL MODEL INDEX                                 D  48
C     M         PRINT LOOP INDEX                                         D  49
C     MH        INDEX USED FOR 3.5 - 4.2 MICRON WATER CONTINUUM TABLE    D  50
C               LOOK-UP                                                  D  51
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C     P          ATMOSPHERIC LEVEL PRESSURE - INPUT DATA                    D  52
C     PBAR       AVERAGE LAYER PRESSURE                                     D  53
C     SEC        SECANT ANGLE                                               D  54
C     T          ATMOSPHERIC LAYER TEMPERATURE - INPUT DATA                 D  55
C     TA1        CLEAR* AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA        D  56
C     TA2        HAZY* AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA         D  57
C     TBAR       AVERAGE LAYER TEMPERATURE                                  D  58
C     TDEP       INTERMEDIATE CONSTANT FOR THE 3.5-4.2 H2O CONTINUUM        D  59
C                CALCULATION                                                D  60
C     TM         RAYLEIGH (MOLECULAR) SCATTERING COEFFICIENT                D  61
C                - OUTPUT DATA                                              D  62
C     TN2        ABSORPTION COEFFICIENT DUE TO NITROGEN CONTINUUM           D  63
C     TX5        INTERMEDIATE CONSTANT FOR THE 3.5-4.2 H2O CONTINUUM        D  64
C                CALCULATION                                                D  65
C     V          FREQUENCY AT WHICH THE EXTINCTION COEFFICIENT ARE BEING    D  66
C                CALCULATED - INPUT DATA                                    D  67
C     W          ABSORBER CONCENTRATION                                     D  68
C     WG         SEALEVEL VALUES OF MOLECULAR ABUNDANCES                    D  69
C     XH         INTERMEDIATE CONSTANT FOR THE 3.5-4.2 H2O CONTINUUM        D  70
C                CALCULATION                                                D  71
C     XI         INTERMEDIATE CONSTANT FOR THE 3.5-4.2 H2O CONTINUUM        D  72
C                CALCULATION                                                D  73
C     Z          ATMOSPHERIC HEIGHT (KM)                                    D  74
      COMMON GNU(1000),S(1000),ALFA0(1000),EPP(1000),MOL(1000)              D  75
      COMMON Z(40),P(6,40),T(6,40),W(6,7,40),CAY(6,40),WG(6,7)              D  76
      COMMON TM(6,40),TA1(4,40),TA2(4,40)                                   D  77
      COMMON FA(7,70),ASC(7,70),AAB(7,70),CAS(7,40),HAS(7,40)               D  78
      COMMON /BLK2/ FKC,CON(20),FN2(100),CN2(100),HZ1(40),HZ2(40)           D  79
      DIMENSION EVM(40)                                                     D  80
      IPRNT=0                                                               D  81
      CC1=273.0/1013.0                                                      D  82
      IF (IPRNT.EQ.1) PRINT 33, (CAY(M,ITP-1),M=1,5)                        D  83
      DO 18 J=1,KSAM                                                        D  84
      DO 17 K=1,ITP                                                         D  85
      DO 1 I=1,4                                                            D  86
      TA1(I,K)=0.0                                                          D  87
      TA2(I,K)=0.0                                                          D  88
      CAS(I,K)=0.0                                                          D  89
      HAS(I,K)=0.0                                                          D  90
1     CONTINUE                                                              D  91
      IF (K.EQ.ITP) TBAR=T(J,ITP)                                           D  92
      IF (K.EQ.ITP) GO TO 2                                                 D  93
      PBAR=(P(J,K)+P(J,K+1))/2.0                                            D  94
      TBAR=(T(J,K)+T(J,K+1))/2.0                                            D  95
2     IF (V.LT.2740.0) GO TO 5                                              D  96
C                                                                           D  97
C     RAYLEIGH (MOLECULAR) SCATTERING.                                      D  98
C                                                                           D  99
      IF (K.EQ.ITP) GO TO 3                                                 D 100
      HH=1.0/ALOG((P(J,K+1)*T(J,K))/(P(J,K)*T(J,K+1)))                      D 101
      EVM(K)=CC1*HH*((P(J,K+1)/T(J,K+1))-(P(J,K)/T(J,K)))                   D 102
      GO TO 4                                                               D 103
3     EVM(K)=CC1*P(J,ITP)/T(J,ITP)                                          D 104
4     TM(J,K)=9.807E-20*EVM(K)*V**4.0117                                    D 105
      GO TO 6                                                               D 106
5     TM(J,K)=0.0                                                           D 107
6     IF (V.LT.400.0) GO TO 17                                              D 108
      IF (V.LT.1250.0) GO TO 7                                              D 109
      IF (V.LT.2000.0) GO TO 17                                             D 110
      IF (V.LT.2350.0) GO TO 11                                             D 111
      IF (V.GT.2800.0) GO TO 17                                             D 112
C                                                                           D 113
C   3.5  TO 4.2  MICRON H2O CONTINUM                                        D 114
C                                                                           D 115
      XI=(V-2350.0)/50.0+1.0                                                D 116
      MM=XI+1.001                                                           D 117
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      XH=XI-FLOAT(MM)                                                   D 118
      TX5=CON(MM)                                                       D 119
      TX5=TX5+XH*(CON(MM)-CON(MM-1))                                    D 120
      CCONT=TX5/3.34E+22                                                D 121
      TDEP=EXP(4.56*(296.0/TBAR-1.0))                                   D 122
      CNCS=0.12*TDEP                                                    D 123
      GO TO 8                                                           D 124
C                                                                       D 125
C       8  TO  14  MICROM H2O CONTINUM                                  D 126
C                                                                       D 127
7     CCONT=(4.18+5578.*EXP(-7.87E-3*V))/3.34E+22                       D 128
      TDEP=1.                                                           D 129
      IF (V.GT.700.0) TDEP=EXP(6.08*(296.0/TBAR-1.0))                   D 130
      CNCS=0.002                                                        D 131
8     IF (K.EQ.ITP) GO TO 9                                             D 132
      H2OLAY=W(J,I,K)                                                   D 133
      PH2O=4.712E-23*H2OLAY/ALOG(P(J,K+1)/P(J,K))                       D 134
      GO TO 10                                                          D 135
9     H2OLAY=WG(J,I)                                                    D 136
      PH2O=1.38E-24*H2OLAY*T(J,ITP)                                     D 137
      PBAR=P(J,ITP)                                                     D 138
10    ABSOR=CCONT*(PH2O*TDEP+CNCS*(PBAR-PH2O))/1013.                    D 139
      CAY(J,K)=ABSOR*H2OLAY*SEC+CAY(J,K)                                D 140
      IF (V.GE.2350.0) GO TO 11                                         D 141
      GO TO 17                                                          D 142
C                                                                       D 143
C     COMPUTE NITROGEN CONTINUUM                                        D 144
C                                                                       D 145
11    DO 13 I=1,90                                                      D 146
      IF (V.GE.FN2(I).AND.V.LE.FN2(I+1)) GO TO 12                       D 147
      GO TO 13                                                          D 148
12    DELN2=(CN2(I+1)-CN2(I))/(FN2(I+1)-FN2(I))                         D 149
      CCONT=DELN2*(V-FN2(I))+CN2(I)                                     D 150
      GO TO 14                                                          D 151
13    CONTINUE                                                          D 152
14    IF (K.EQ.ITP) GO TO 15                                            D 153
      DELP=P(J,K+1)-P(J,K)                                              D 154
      TN2=0.781*CCONT*(PBAR/1013.0)*29.24*TBAR*(DELP/1013.0)            D 155
      GO TO 16                                                          D 156
15    PBAR=P(J,ITP)                                                     D 157
      TN2=0.781*CCONT*(PBAR/1013.0)**2*1000.0*296.0/T(J,ITP)            D 158
16    CAY(J,K)=CAY(J,K)+TN2*SEC                                         D 159
17    CONTINUE                                                          D 160
18    CONTINUE                                                          D 161
      IF (V.LT.FA(1,1)) RETURN                                          D 162
C                                                                       D 163
C     COMPUTE AEROSOL EXTINCTION COEFFICIENTS.                          D 164
C                                                                       D 165
      DO 19 J=1,60                                                      D 166
      IF (V.GE.FA(1,J).AND.V.LE.FA(1,J+1)) GO TO 20                     D 167
19    CONTINUE                                                          D 168
      PRINT 34                                                          D 169
      STOP 2                                                            D 170
20    FAC=(V-FA(1,J))/(FA(1,J+1)-FA(1,J))                               D 171
      DO 32 K=1,ITP                                                     D 172
      IF (K.EQ.ITP) GO TO 24                                            D 173
      IF (HZ1(K).EQ.HZ1(K+1)) GO TO 21                                  D 174
      HA1=1.0/ALOG(HZ1(K+1)/HZ1(K))                                     D 175
      EVH1=HA1*(HZ1(K+1)-HZ1(K))                                        D 176
      GO TO 22                                                          D 177
21    EVH1=HZ1(K)                                                       D 178
22    IF (HZ2(K).EQ.HZ2(K+1)) GO TO 23                                  D 179
      HA2=1.0/ALOG(HZ2(K+1)/HZ2(K))                                     D 180
      EVH2=HA2*(HZ2(K+1)-HZ2(K))                                        D 181
      GO TO 25                                                          D 182
23    EVH2=HZ2(K)                                                       D 183
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      GO TO 25                                                          D 184
24    EVH1=HZ1(ITP)                                                     D 185
      EVH2=HZ2(ITP)                                                     D 186
25    IF (Z(K).LE.100.0.AND.Z(K).GE.30.0) GO TO 26                      D 187
      IF (Z(K).LE.30.0.AND.Z(K).GE.9.0) GO TO 27                        D 188
      IF (Z(K).LE.9.0.AND.Z(K).GE.2.0) GO TO 28                         D 189
      IF (Z(K).LE.2.0.AND.Z(K).GE.0.0) GO TO 29                         D 190
C     METEORIC DUST MODEL                                               D 191
26    LC=7                                                              D 192
      LH=7                                                              D 193
      GO TO 30                                                          D 194
C     CLEAR: BACKGROUND STRATOSPHERIC, HAZY: AGED VOLCANIC              D 195
27    LC=5                                                              D 196
      LH=6                                                              D 197
      GO TO 30                                                          D 198
C     TROPOSPHERIC MODEL                                                D 199
28    LC=2                                                              D 200
      LH=2                                                              D 201
      GO TO 30                                                          D 202
C     RURAL MODEL                                                       D 203
29    LC=1                                                              D 204
      LH=1                                                              D 205
30    AKCL=(AAB(LC,J+1)-AAB(LC,J))*FAC+AAB(LC,J)                        D 206
      AKHZ=AKCL                                                         D 207
      ASCL=(ASC(LC,J+1)-ASC(LC,J))*FAC+ASC(LC,J)                        D 208
      ASHZ=ASCL                                                         D 209
      IF (LC.EQ.LH) GO TO 31                                            D 210
      AKHZ=(AAB(LH,J+1)-AAB(LH,J))*FAC+AAB(LH,J)                        D 211
      ASHZ=(ASC(LH,J+1)-ASC(LH,J))*FAC+ASC(LH,J)                        D 212
31    TA1(1,K)=EVH1*AKCL                                                D 213
      TA2(1,K)=EVH2*AKHZ                                                D 214
      CAS(1,K)=EVH1*ASCL                                                D 215
      HAS(1,K)=EVH2*ASHZ                                                D 216
      IF (K.LT.ITP) GO TO 32                                            D 217
      AKHZ=(AAB(4,J+1)-AAB(4,J))*FAC+AAB(4,J)                           D 218
      ASHZ=(ASC(4,J+1)-ASC(4,J))*FAC+ASC(4,J)                           D 219
      TA2(4,ITP)=EVH2*AKHZ                                              D 220
      HAS(4,ITP)=EVH2*ASHZ                                              D 221
      AKCL=(AAB(3,J+1)-AAB(3,J))*FAC+AAB(3,J)                           D 222
      AKHZ=AKCL                                                         D 223
      ASCL=(ASC(3,J+1)-ASC(3,J))*FAC+ASC(3,J)                           D 224
      ASHZ=ASCL                                                         D 225
      TA1(3,ITP)=EVH1*AKCL                                              D 226
      TA2(3,ITP)=EVH2*AKHZ                                              D 227
      CAS(3,ITP)=EVH1*ASCL                                              D 228
      HAS(3,ITP)=EVH2*ASHZ                                              D 229
      AKCL=(AAB(2,J+1)-AAB(2,J))*FAC+AAB(2,J)                           D 230
      ASCL=(ASC(2,J+1)-ASC(2,J))*FAC+ASC(2,J)                           D 231
      TA1(2,ITP)=EVH1*AKCL                                              D 232
      CAS(2,ITP)=EVH1*ASCL                                              D 233
32    CONTINUE                                                          D 234
      RETURN                                                            D 235
C                                                                       D 236
33    FORMAT (5E15.5)                                                   D 237
34    FORMAT (* FREQUENCY IS OUTSIDE RANGE OF AEROSOL DATA *)           D 238
      END                                                               D 239-
      FUNCTION VOIGT (X,Y)                                              E   1
      COMMON /BLK3/ NH,HH(10),XX(10),A(42)                              E   2
      DIMENSION RA(32), CA(32), RB(32), CB(32), B(44), AK(6), AM(6), DY(E   3
     14)                                                                E   4
      X2=X*X                                                            E   5
      Y2=Y*Y                                                            E   6
      IF (X-5.0) 1,24,24                                                E   7
1     IF (Y-1.) 6,6,2                                                   E   8
2     RA(1)=0.                                                          E   9
      CA(1)=0.                                                          E  10
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```
      RB(1)=1.                                                          E  11
      CB(1)=0.                                                          E  12
      RA(2)=X                                                           E  13
      CA(2)=Y                                                           E  14
      RB(2)=.5-X2+Y2                                                    E  15
      CB(2)=-2.*X*Y                                                     E  16
      CB1=CB(2)                                                         E  17
      CA1=0.                                                            E  18
      UV1=0.                                                            E  19
      DO 4 J=2,31                                                       E  20
      JPLUS=J+1                                                         E  21
      JMINUS=J-1                                                        E  22
      FLOATJ=JMINUS                                                     E  23
      RB1=2.*FLOATJ*RB(2)                                               E  24
      RA1=-FLOATJ*(2.*FLOATJ-1.)/2.                                     E  25
      RA(JPLUS)=RB1*RA(J)-CB1*CA(J)+RA1*RA(JMINUS)-CA1*CA(JMINUS)       E  26
      CA(JPLUS)=RB1*CA(J)+CB1*RA(J)+RA1*CA(JMINUS)+CA1*RA(JMINUS)       E  27
      RB(JPLUS)=RB1*RB(J)-CB1*CB(J)+RA1*RB(JMINUS)-CA1*CB(JMINUS)       E  28
      CB(JPLUS)=RB1*CB(J)+CB1*RB(J)+RA1*CB(JMINUS)+CA1*RB(JMINUS)       E  29
      IF (JPLUS.GE.13) PRINT 31, JPLUS,RA(JPLUS),CB(JPLUS),CA(JPLUS),RB(E  30
     1JPLUS),X,Y                                                        E  31
      IF (RA(JPLUS).GT.1.0E+10) PRINT 31, JPLUS,RA(JPLUS),CB(JPLUS),CA(JE  32
     1PLUS),RB(JPLUS),X,Y                                               E  33
      IF (CB(JPLUS).GT.1.0E+10) PRINT 31, JPLUS,RA(JPLUS),CB(JPLUS),CA(JE  34
     1PLUS),RB(JPLUS),X,Y                                               E  35
      UV=(CA(JPLUS)*RB(JPLUS)-RA(JPLUS)*CB(JPLUS))/(RB(JPLUS)*RB(JPLUS)+E  36
     1CB(JPLUS)*CB(JPLUS))                                              E  37
      IF (Y.LT.1.5) GO TO 3                                             E  38
      IF (ABS(UV-UV1)-1.E-6) 5,4,4                                      E  39
3     IF (ABS(UV-UV1)-1.0E-5) 5,4,4                                     E  40
4     UV1=UV                                                            E  41
5     VOIGT=UV/1.772454                                                 E  42
      RETURN                                                            E  43
6     IF (X-2.) 7,7,9                                                   E  44
7     AINT=1.                                                           E  45
      MAX=12.+5.*X2                                                     E  46
      DO 8 K=1,MAX                                                      E  47
      AJ=MAX+1-K                                                        E  48
8     AINT=AINT*(-2.*X2)/(2.*AJ+1.)+1.                                  E  49
      U=-2.*X*AINT                                                      E  50
      GO TO 14                                                          E  51
9     IF (X-4.5) 10,12,12                                               E  52
10    B(43)=0.                                                          E  53
      B(44)=0.                                                          E  54
      J=42                                                              E  55
      DO 11 K=1,42                                                      E  56
      B(J)=.4*X*B(J+1)-B(J+2)+A(J)                                      E  57
11    J=J-1                                                             E  58
      U=B(1)-B(2)                                                       E  59
      GO TO 14                                                          E  60
12    AINT=1.0                                                          E  61
      MAX=2.+40./X                                                      E  62
      AMAX=MAX                                                          E  63
      DO 13 K=1,MAX                                                     E  64
      AINT=AINT*(2.*AMAX-1.)/(2.*X2)+1.                                 E  65
13    AMAX=AMAX-1.                                                      E  66
      U=-AINT/X                                                         E  67
14    V=1.772454/EXP(X2)                                                E  68
      H=.02                                                             E  69
      JM=Y/H                                                            E  70
      IF (JM) 16,15,16                                                  E  71
15    H=Y                                                               E  72
16    Z=0.                                                              E  73
      L=0                                                               E  74
      DY(1)=0.                                                          E  75
17    DY(2)=H/2.                                                        E  76
```

```
      DY(3)=DY(2)                                                       E  77
      DY(4)=H                                                           E  78
18    AK(1)=0.                                                          E  79
      AM(1)=0.                                                          E  80
      DO 20 J=1,4                                                       E  81
      YY=Z+DY(J)                                                        E  82
      UU=U+.5*AK(J)                                                     E  83
      VV=V+.5*AM(J)                                                     E  84
      AK(J+1)=2.*(YY*UU+X*VV)*H                                         E  85
      AM(J+1)=-2.*(1.+X*UU-YY*VV)*H                                     E  86
      IF (J-3) 20,19,20                                                 E  87
19    AK(4)=2.*AK(4)                                                    E  88
      AM(4)=AM(4)+AM(4)                                                 E  89
20    CONTINUE                                                          E  90
      Z=Z+H                                                             E  91
      L=L+1                                                             E  92
      U=U+.1666667*(AK(2)+2.*AK(3)+AK(4)+AK(5))                         E  93
      V=V+.1666667*(AM(2)+AM(3)+AM(3)+AM(4)+AM(5))                      E  94
      IF (JM) 21,23,21                                                  E  95
21    IF (L-JM) 18,22,23                                                E  96
22    AJM=JM                                                            E  97
      H=Y-AJM*H                                                         E  98
      GO TO 17                                                          E  99
23    VOIGT=V/1.772454                                                  E 100
      RETURN                                                            E 101
24    IF (Y) 25,26,26                                                   E 102
25    PRINT 32, Y                                                       E 103
      CALL EXIT                                                         E 104
26    IF (X2-88.) 28,28,27                                              E 105
27    VOIGT=0.                                                          E 106
      RETURN                                                            E 107
28    VOIGT=1./EXP(X2)                                                  E 108
      RETURN                                                            E 109
29    F1=0.                                                             E 110
      DO 30 J=1,NH                                                      E 111
30    F1=F1+HH(J)/(Y2+(X-XX(J))*(X-XX(J)))+HH(J)/(Y2+(X+XX(J))*(X+XX(J)E 112
     1)                                                                 E 113
      VOIGT=Y*F1/3.1415927                                              E 114
      RETURN                                                            E 115
C                                                                       E 116
31    FORMAT (I5,4HRA =E13.6,4HRB =E13.6,4HCA =E13.6,4HRB =E13.6,3HX =E1E 117
     13.6,3HY =E13.6)                                                   E 118
32    FORMAT (38H0ERROR VOIGT - RATIO LORENTZ/DOPPLER =,E15.7)          E 119
      END                                                               E 120
      SUBROUTINE PRNT                                                   F   1
      COMMON /BLK1/ JT,DNU(20),CHI(20),AML(40)                          F   2
      COMMON /BLK2/ FKC,CON(20),FN2(100),CN2(100),HZ1(40),HZ2(40)       F   3
      COMMON /BLK3/ NH,HH(10),XX(10),A(42)                              F   4
      DATA ITP/33/                                                      F   5
      PRINT 1                                                           F   6
      PRINT 2, FKC,(CON(I),I=1,15)                                      F   7
      PRINT 3, (FN2(I),CN2(I),I=1,91)                                   F   8
      PRINT 4, JT,(DNU(I),CHI(I),I=1,JT)                                F   9
      PRINT 5, NH,(HH(I),XX(I),I=1,NH)                                  F  10
      PRINT 6, (A(I),I=1,42)                                            F  11
      PRINT 7, ITP,(HZ1(I),I=1,ITP)                                     F  12
      PRINT 8, ITP,(HZ2(I),I=1,ITP)                                     F  13
      PRINT 1                                                           F  14
      PRINT 9, ITP,(AML(I),I=1,ITP)                                     F  15
      RETURN                                                            F  16
C                                                                       F  17
1     FORMAT (1H1)                                                      F  18
2     FORMAT (51X,*WATER VAPOR CONTINUUM COEFFICIENTS*/55X,*FOR 3.5 - 4.F  19
     12 MICRONS (CON)*//42X,*FKC(1)=*F7.1//(41X,6(1PE9.2)))            F  20
3     FORMAT (////47X,*NITROGEN CONTINUUM ABSORPTION COEFFICIENTS*/62X,*F  21
     1(FN2 VS CN2)*//(22X,5(0PF9.1,1PE9.2)))                           F  22
```

```
4     FORMAT (////51X,*MODIFICATION TO LORENTZ LINE SHAPE*/62X,*(ONU VS    F  23
     1CHI)*//42X,*JT=*I4/(40X,5(F6.1,F6.2)))                               F  24
5     FORMAT (1H1,53X,*INPUT DATA FOR VOIGT (HH, XX)*//54X,*NH=*I2/(53X,    F  25
     12(1PE15.8)))                                                         F  26
6     FORMAT (////56X,*INPUT DATA FOR VOIGT (A)*//(37X,4(1PE15.7)))         F  27
7     FORMAT (////45X,*VERTICAL SCALING FACTOR FOR CLEAR AEROSOL MODEL*/    F  28
     1/44X,*ITP=*I3/(43X,5(1PE10.3)))                                      F  29
8     FORMAT (////45X,*VERTICAL SCALING FACTOR FOR HAZY AEROSOL MODEL*//    F  30
     144X,*ITP=*I3/(43X,5(1PE10.3)))                                       F  31
9     FORMAT (////57X,*HEIGHT INCREMENTS (AML)*//47X,*ITP=*I3/(44X,5A10)    F  32
     1)                                                                    F  33
      END                                                                  F  34-
      BLOCK DATA                                                           G   1
      COMMON /BLK1/ JT,ONU(20),CHI(20),AML(40)                             G   2
      COMMON /BLK2/ FKC,CON(20),FN2(100),CN2(100),HZ1(40),HZ2(40)          G   3
      COMMON /BLK3/ NH,HH(10),XX(10),A(42)                                 G   4
      DATA JT,NH,FKC/16,3,.3350.0/                                         G   5
      DATA (CON(I),I=1,15)/.230,.187,.147,.117,.097,.087,.100,.120,.147,   G   6
     1.174,.200,.240,.280,.330,0.000/                                      G   7
      DATA (FN2(I),I=1,91)/2000.0,2050.0,2075.0,2100.0,2125.0,2150.0,215   G   8
     15.0,2160.0,2165.0,2170.0,2175.0,2180.0,2185.0,2190.0,2195.0,2200.0   G   9
     2,2205.0,2210.0,2215.0,2220.0,2225.0,2230.0,2235.0,2240.0,2245.0,22   G  10
     350.0,2255.0,2260.0,2265.0,2270.0,2275.0,2280.0,2285.0,2290.0,2295.   G  11
     40,2300.0,2305.0,2310.0,2315.0,2320.0,2325.0,2330.0,2335.0,2340.0,2   G  12
     5345.0,2350.0,2355.0,2360.0,2365.0,2370.0,2375.0,2380.0,2385.0,2390   G  13
     6.0,2395.0,2400.0,2405.0,2410.0,2415.0,2420.0,2425.0,2430.0,2435.0,   G  14
     72440.0,2445.0,2450.0,2455.0,2460.0,2465.0,2470.0,2475.0,2480.0,248   G  15
     85.0,2490.0,2495.0,2500.0,2505.0,2510.0,2515.0,2520.0,2525.0,2530.0   G  16
     9,2535.0,2540.0,2545.0,2550.0,2575.0,2600.0,2625.0,2650.0,2800.0/     G  17
      DATA (CN2(I),I=1,91)/1.00E-21,1.20E-07,1.80E-07,6.30E-07,2.00E-06,   G  18
     19.00E-06,1.13E-05,1.36E-05,1.66E-05,1.96E-05,2.16E-05,2.36E-05,2.6   G  19
     23E-05,2.90E-05,3.15E-05,3.40E-05,3.66E-05,3.92E-05,4.26E-05,4.60E-   G  20
     305,4.95E-05,5.30E-05,5.65E-05,6.00E-05,6.30E-05,6.60E-05,6.89E-05,   G  21
     47.18E-05,7.39E-05,7.60E-05,7.84E-05,8.08E-05,8.39E-05,8.70E-05,9.1   G  22
     53E-05,9.56E-05,1.08E-04,1.20E-04,1.36E-04,1.52E-04,1.60E-04,1.69E-   G  23
     604,1.60E-04,1.51E-04,1.37E-04,1.23E-04,1.19E-04,1.16E-04,1.14E-04,   G  24
     71.12E-04,1.12E-04,1.11E-04,1.11E-04,1.12E-04,1.14E-04,1.14E-04,1.1   G  25
     82E-04,1.10E-04,1.07E-04,1.02E-04,9.90E-05,9.50E-05,9.00E-05,8.65E-   G  26
     905,8.20E-05,7.65E-05,7.05E-05,6.50E-05,6.10E-05,5.50E-05,4.95E-05,   G  27
     X4.50E-05,4.00E-05,3.75E-05,3.50E-05,3.10E-05,2.65E-05,2.50E-05,2.2   G  28
     10E-05,1.95E-05,1.75E-05,1.60E-05,1.40E-05,1.20E-05,1.05E-05,9.50E-   G  29
     206,6.00E-06,3.50E-06,2.00E-06,1.50E-06,1.00E-20/                     G  30
      DATA (ONU(I),I=1,16)/0.0,.5,.6,.7,.8,.9,1.0,1.2,1.5,2.0,2.5,3.0,5.   G  31
     10,8.0,10.0,15.0/                                                     G  32
      DATA (CHI(I),I=1,16)/1.00,1.00,.96,.89,.82,.77,.70,.60,.50,.41,.34   G  33
     1,.31,.29,.23,.19,0.00/                                               G  34
      DATA (HH(I),I=1,3)/7.24629599E-01,1.57067320E-01,4.53000990E-03/     G  35
      DATA (XX(I),I=1,3)/4.36077410E-01,1.33584900E+00,2.35060497E+00/     G  36
      DATA (A(I),I=1,42)/0.,1.9999999F-01,0.,-1.8400000F-01,0.,1.5583999   G  37
     1F-01,0.,-1.2166400E-01,0.,8.7708159E-02,0.,-5.8514124F-02,0.,3.621   G  38
     25730E-02,0.,-2.0849765E-02,0.,1.1196011E-02,0.,-5.8231896E-03,0.,2   G  39
     3.6487534E-03,0.,-1.1732670F-03,0.,4.8995199E-04,0.,-1.9336308E-04,   G  40
     40.,7.2267745E-05,0.,-2.5655512E-05,0.,8.6620736E-06,0.,-2.7876379E   G  41
     5-06,0.,8.5668736E-07,0.,-2.5184337E-07,0.,7.0936022E-08/             G  42
      DATA (HZ1(I),I=1,33)/9.30E-10,1.60E-07,2.10E-06,4.02E-06,8.00E-06,   G  43
     11.65E-05,3.32E-05,1.50E-04,1.90E-04,2.42E-04,2.96E-04,3.52E-04,4.2   G  44
     23E-04,4.92E-04,5.63E-04,6.01E-04,6.41E-04,6.43E-04,6.45E-04,6.22E-   G  45
     304,6.63E-04,7.14E-04,7.87E-04,9.80E-04,1.41E-03,2.30E-03,3.54E-03,   G  46
     44.85E-03,6.43E-03,8.19E-03,9.70E-03,2.65E-02,6.95E-02/               G  47
      DATA (HZ2(I),I=1,33)/9.30E-10,1.60E-07,2.10E-06,4.02E-06,8.00E-06,   G  48
     12.45E-05,7.60E-05,4.16E-04,5.15E-04,6.60E-04,8.60E-04,1.09E-03,1.3   G  49
     25E-03,1.71F-03,2.10E-03,2.46E-03,2.74E-03,2.92E-03,2.89E-03,2.80E-   G  50
     303,2.45E-03,2.11E-03,1.85F-03,1.81E-03,3.36E-03,8.22E-03,7.71E-03,   G  51
     49.30E-03,1.85E-02,3.46E-02,6.21E-02,7.57E-01,7.57E-01/               G  52
      DATA (AML(I),I=1,33)/10H 70 -100  ,10H 50 - 70  ,10H 45 - 50  ,10H   G  53
     1 40 - 45  ,10H 35 - 40  ,10H 30 - 35  ,10H 25 - 30  ,10H 24 - 25     G  54
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    2,10H 23 - 24  ,10H 22 - 23  ,10H 21 - 22  ,10H 20 - 21  ,10H 19 -   G  55
    320  ,10H 18 - 19  ,10H 17 - 18  ,10K 16 - 17  ,10H 15 - 16  ,10H 1  G  56
    44 - 15  ,10H 13 - 14  ,10H 12 - 13  ,10H 11 - 12  ,10H 10 - 11  ,1  G  57
    50H  9 - 10  ,10H  8 -  9  ,10H  7 -  8  ,10H  6 -  7  ,10H  5 -  6  G  58
    3  ,10H  4 -  5  ,10H  3 -  4  ,10H  2 -  3  ,10H  1 -  2  ,10H  0    G  59
    7- 1  ,10H    0    /                                                  G  60
     END                                                                 G  61-
33  1.000  6
 6.36E+22  8.08E+20  7.03E+16  6.85E+17  1.84E+17  3.92E+18  5.13E+23
 4.69E+22  8.24E+20  7.53E+16  6.99E+17  1.87E+17  4.00E+18  5.23E+23
 1.17E+22  8.95E+20  7.53E+16  7.59E+17  2.03E+17  4.34E+18  5.68E+23
 3.05E+22  8.42E+20  6.15E+16  7.14E+17  1.91E+17  4.08E+18  5.35E+23
 4.01E+21  9.43E+20  5.15E+16  8.00E+17  2.14E+17  4.57E+18  5.98E+23
 1.97E+22  8.41E+20  6.78E+16  7.14E+17  1.91E+17  4.08E+18  5.34E+23
    TROPICAL      MIDLATITUDE SUMMER
  0.0 1.013E+03 300.0   1.9E 01  5.6E-05 1.013E+03 294.0   1.4E 01  6.0E-05
  1.0 9.040E+02 294.0   1.3E+01  5.6E-05 9.020E+02 290.0   9.3E+00  6.0E-05
  2.0 8.050E+02 288.0   9.3E+00  5.4E-05 8.020E+02 285.0   5.9E+00  6.0E-05
  3.0 7.150E+02 284.0   4.7E+00  5.1E-05 7.100E+02 279.0   3.3E+00  6.2E-05
  4.0 6.330E+02 277.0   2.2E+00  4.7E-05 6.280E+02 273.0   1.9E+00  6.4E-05
  5.0 5.590E+02 270.0   1.5E+00  4.5E-05 5.540E+02 267.0   1.0E+00  6.6E-05
  6.0 4.920E+02 264.0   8.5E-01  4.3E-05 4.870E+02 261.0   6.1E-01  6.9E-05
  7.0 4.320E+02 257.0   4.7E-01  4.1E-05 4.260E+02 255.0   3.7E-01  7.5E-05
  8.0 3.780E+02 250.0   2.5E-01  3.9E-05 3.720E+02 248.0   2.1E-01  7.9E-05
  9.0 3.290E+02 244.0   1.2E-01  3.9E-05 3.240E+02 242.0   1.2E-01  8.6E-05
 10.0 2.860E+02 237.0   5.0E-02  3.9E-05 2.810E+02 235.0   6.4E-02  9.0E-05
 11.0 2.470E+02 230.0   1.7E-02  4.1E-05 2.430E+02 229.0   2.2E-02  1.1E-04
 12.0 2.139E+02 224.0   6.0E-03  4.3E-05 2.090E+02 222.0   6.0E-03  1.2E-04
 13.0 1.820E+02 217.0   1.8E-03  4.5E-05 1.790E+02 216.0   1.8E-03  1.5E-04
 14.0 1.560E+02 210.0   1.0E-03  4.5E-05 1.530E+02 216.0   1.0E-03  1.8E-04
 15.0 1.320E+02 204.0   7.6E-04  4.7E-05 1.300E+02 216.0   7.6E-04  1.9E-04
 16.0 1.110E+02 197.0   6.4E-04  4.7E-05 1.110E+02 216.0   6.4E-04  2.1E-04
 17.0 9.370E+01 195.0   5.6E-04  6.9E-05 9.500E+01 216.0   5.6E-04  2.4E-04
 18.0 7.890E+01 199.0   5.0E-04  9.0E-05 8.120E+01 216.0   5.0E-04  2.8E-04
 19.0 6.660E+01 203.0   4.9E-04  1.4E-04 6.950E+01 217.0   4.9E-04  3.2E-04
 20.0 5.650E+01 207.0   4.5E-04  1.9E-04 5.950E+01 218.0   4.5E-04  3.4E-04
 21.0 4.800E+01 211.0   5.1E-04  2.4E-04 5.100E+01 219.0   5.1E-04  3.6E-04
 22.0 4.090E+01 215.0   5.1E-04  2.8E-04 4.370E+01 220.0   5.1E-04  3.6E-04
 23.0 3.500E+01 217.0   5.4E-04  3.2E-04 3.760E+01 222.0   5.4E-04  3.4E-04
 24.0 3.000E+01 219.0   6.0E-04  3.4E-04 3.220E+01 223.0   6.0E-04  3.2E-04
 25.0 2.570E+01 221.0   6.7E-04  3.4E-04 2.770E+01 224.0   6.7E-04  3.0E-04
 30.0 1.220E+01 232.0   3.6E-04  2.4E-04 1.320E+01 234.0   3.6E-04  2.0E-04
 35.0 6.000E+00 243.0   1.1E-04  9.2E-05 6.520E+00 245.0   1.1E-04  9.2E-05
 40.0 3.050E+00 254.0   4.3E-05  4.1E-05 3.330E+00 258.0   4.3E-05  4.1E-05
 45.0 1.590E+00 265.0   1.9E-05  1.3E-05 1.760E+00 270.0   1.9E-05  1.3E-05
 50.0 8.540E-01 270.0   6.3E-06  4.3E-06 9.510E-01 276.0   6.3E-06  4.3E-06
 70.0 5.799E-02 219.0   1.4E-07  8.6E-08 6.710E-02 218.0   1.4E-07  8.6E-08
100.0 3.000E-04 210.0   1.0E-09  4.3E-11 3.000E-04 210.0   1.0E-09  4.3E-11
MIDLATITUDE WINTER SUBARCTIC SUMMER
  0.0 1.018E+03 272.2   3.5E+00  6.0E-05 1.010E+03 287.0   9.1E+00  4.9E-05
  1.0 8.973E+02 268.7   2.5E+00  5.4E-05 8.960E+02 282.0   6.0E+00  5.4E-05
  2.0 7.897E+02 265.2   1.8E+00  4.9E-05 7.929E+02 276.0   4.2E+00  5.6E-05
  3.0 6.939E+02 261.7   1.2E+00  4.9E-05 7.000E+02 271.0   2.7E+00  5.8E-05
  4.0 6.081E+02 255.7   6.6E-01  4.9E-05 6.160E+02 266.0   1.7E+00  6.0E-05
  5.0 5.313E+02 249.7   3.8E-01  5.8E-05 5.410E+02 260       .0E+00  6.4E-05
  6.0 4.627E+02 243.7   2.1E-01  6.4E-05 4.730E+02 253.0   5.4E-01  7.1E-05
  7.0 4.016E+02 237.7   8.5E-02  7.7E-05 4.130E+02 246.0   2.9E-01  7.5E-05
  8.0 3.473E+02 231.7   3.5E-02  9.0E-05 3.590E+02 239.0   1.3E-01  7.9E-05
  9.0 2.992E+02 225.7   1.6E-02  1.2E-04 3.107E+02 232.0   4.2E-02  1.1E-04
 10.0 2.568E+02 219.7   7.5E-03  1.6E-04 2.677E+02 225.0   1.5E-02  1.3E-04
 11.0 2.199E+02 219.2   6.9E-03  2.1E-04 2.300E+02 225.0   9.4E-03  1.4E-04
 12.0 1.882E+02 218.7   6.0E-03  2.6E-04 1.977E+02 225.0   6.0E-03  2.1E-04
 13.0 1.610E+02 218.2   1.8E-03  3.0E-04 1.700E+02 225.0   1.8E-03  2.6E-04
 14.0 1.378E+02 217.7   1.0E-03  3.2E-04 1.460E+02 225.0   1.0E-03  2.8E-04
 15.0 1.178E+02 217.2   7.6E-04  3.4E-04 1.250E+02 225.0   7.6E-04  3.2E-04
 16.0 1.007E+02 216.7   6.4E-04  3.6E-04 1.080E+02 225.0   6.4E-04  3.4E-04
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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17.0 | 8.610E+01 | 216.2 | 5.6E-04 | 3.9E-04 | 9.280E+01 | 225.0 | 5.6E-04 | 3.9E-04 |
| 18.0 | 7.350E+01 | 215.7 | 5.0E-04 | 4.1E-04 | 7.980E+01 | 225.0 | 5.0E-04 | 4.1E-04 |
| 19.0 | 6.280E+01 | 215.2 | 4.9E-04 | 4.3E-04 | 6.860E+01 | 225.0 | 4.9E-04 | 4.1E-04 |
| 20.0 | 5.370E+01 | 215.2 | 4.5E-04 | 4.5E-04 | 5.890E+01 | 225.0 | 4.5E-04 | 3.9E-04 |
| 21.0 | 4.590E+01 | 215.2 | 5.1E-04 | 4.3E-04 | 5.070E+01 | 225.0 | 5.1E-04 | 3.6E-04 |
| 22.0 | 3.910E+01 | 215.2 | 5.1E-04 | 4.3E-04 | 4.360E+01 | 225.0 | 5.1E-04 | 3.2E-04 |
| 23.0 | 3.340E+01 | 215.2 | 5.4E-04 | 3.9E-04 | 3.750E+01 | 225.0 | 5.4E-04 | 3.0E-04 |
| 24.0 | 2.860E+01 | 215.2 | 6.0E-04 | 3.6E-04 | 3.227E+01 | 226.0 | 6.0E-04 | 2.8E-04 |
| 25.0 | 2.430E+01 | 215.2 | 6.7E-04 | 3.4E-04 | 2.780E+01 | 228.0 | 6.7E-04 | 2.6E-04 |
| 30.0 | 1.110E+01 | 217.4 | 3.6E-04 | 1.9E-04 | 1.340E+01 | 235.0 | 3.6E-04 | 1.4E-04 |
| 35.0 | 5.180E+00 | 227.8 | 1.1E-04 | 9.2E-05 | 6.610E+00 | 247.0 | 1.1E-04 | 9.2E-05 |
| 40.0 | 2.530E+00 | 243.2 | 4.3E-05 | 4.1E-05 | 3.400E+00 | 262.0 | 4.3E-05 | 4.1E-05 |
| 45.0 | 1.290E+00 | 258.5 | 1.9E-05 | 1.3E-05 | 1.810E+00 | 274.0 | 1.9E-05 | 1.3E-05 |
| 50.0 | 6.820E-01 | 265.7 | 6.3E-06 | 4.3E-06 | 9.970E-01 | 277.0 | 6.3E-06 | 4.3E-06 |
| 70.0 | 4.670E-02 | 230.7 | 1.4E-07 | 8.6E-08 | 7.070E-02 | 216.0 | 1.4E-07 | 8.6E-08 |
| 100.0 | 3.000E-04 | 210.2 | 1.0E-09 | 4.3E-11 | 3.000E-04 | 210.0 | 1.0E-09 | 4.3E-11 |
| SUBARCTIC WINTER | | U.S. | STANDARD | | | | | |
| 0.0 | 1.013E+03 | 257.1 | 1.2E+00 | 4.1E-05 | 1.013E+03 | 288.1 | 5.9E+00 | 5.4E-05 |
| 1.0 | 8.879E+02 | 259.1 | 1.2E+00 | 4.1E-05 | 8.986E+02 | 281.6 | 4.2E+00 | 5.4E-05 |
| 2.0 | 7.775E+02 | 255.9 | 9.4E-01 | 4.1E-05 | 7.950E+02 | 275.1 | 2.9E+00 | 5.4E-05 |
| 3.0 | 6.798E+02 | 252.7 | 6.8E-01 | 4.3E-05 | 7.012E+02 | 269.7 | 1.8E+00 | 5.0E-05 |
| 4.0 | 5.932E+02 | 247.7 | 4.1E-01 | 4.5E-05 | 6.166E+02 | 262.2 | 1.1E+00 | 4.6E-05 |
| 5.0 | 5.158E+02 | 240.9 | 2.0E-01 | 4.7E-05 | 5.405E+02 | 255.7 | 6.4E-01 | 4.6E-05 |
| 6.0 | 4.467E+02 | 234.1 | 9.8E-02 | 4.9E-05 | 4.722E+02 | 249.2 | 3.8E-01 | 4.5E-05 |
| 7.0 | 3.853E+02 | 227.7 | 5.4E-02 | 7.1E-05 | 4.111E+02 | 242.7 | 2.1E-01 | 4.9E-05 |
| 8.0 | 3.308E+02 | 220.6 | 1.1E-02 | 9.0E-05 | 3.565E+02 | 236.2 | 1.2E-01 | 5.2E-05 |
| 9.0 | 2.829E+02 | 217.2 | 8.4E-03 | 1.6E-04 | 3.080E+02 | 229.7 | 4.6E-02 | 7.1E-05 |
| 10.0 | 2.418E+02 | 217.2 | 5.5E-03 | 2.4E-04 | 2.650E+02 | 223.2 | 1.9E-02 | 9.0E-05 |
| 11.0 | 2.067E+02 | 217.2 | 3.8E-03 | 3.2E-04 | 2.270E+02 | 216.8 | 8.2E-03 | 1.3E-04 |
| 12.0 | 1.766E+02 | 217.2 | 2.6E-03 | 4.3E-04 | 1.940E+02 | 216.6 | 3.7E-03 | 1.6E-04 |
| 13.0 | 1.510E+02 | 217.2 | 1.8E-03 | 4.7E-04 | 1.659E+02 | 216.6 | 1.3E-03 | 1.7E-04 |
| 14.0 | 1.291E+02 | 217.2 | 1.0E-03 | 4.9E-04 | 1.417E+02 | 216.6 | 8.4E-04 | 1.9E-04 |
| 15.0 | 1.103E+02 | 217.2 | 7.6E-04 | 5.6E-04 | 1.211E+02 | 216.6 | 7.2E-04 | 2.1E-04 |
| 16.0 | 9.431E+01 | 216.6 | 6.4E-04 | 6.2E-04 | 1.035E+02 | 216.6 | 6.1E-04 | 2.4E-04 |
| 17.0 | 8.059E+01 | 216.0 | 5.6E-04 | 6.2E-04 | 8.850E+01 | 216.6 | 5.2E-04 | 2.4E-04 |
| 18.0 | 6.882E+01 | 215.4 | 5.0E-04 | 6.2E-04 | 7.565E+01 | 216.6 | 4.4E-04 | 3.2E-04 |
| 19.0 | 5.875E+01 | 214.8 | 4.9E-04 | 6.0E-04 | 6.467E+01 | 216.6 | 4.4E-04 | 3.5E-04 |
| 20.0 | 5.014E+01 | 214.1 | 4.5E-04 | 5.6E-04 | 5.529E+01 | 216.6 | 4.4E-04 | 3.8E-04 |
| 21.0 | 4.277E+01 | 213.6 | 5.1E-04 | 5.1E-04 | 4.729E+01 | 217.6 | 4.8E-04 | 3.8E-04 |
| 22.0 | 3.647E+01 | 213.0 | 5.1E-04 | 4.7E-04 | 4.047E+01 | 218.6 | 5.2E-04 | 3.9E-04 |
| 23.0 | 3.109E+01 | 212.4 | 5.4E-04 | 4.3E-04 | 3.467E+01 | 219.6 | 5.7E-04 | 3.9E-04 |
| 24.0 | 2.649E+01 | 211.8 | 6.0E-04 | 3.6E-04 | 2.972E+01 | 220.6 | 6.1E-04 | 3.6E-04 |
| 25.0 | 2.256E+01 | 211.2 | 6.7E-04 | 3.2E-04 | 2.549E+01 | 221.6 | 6.6E-04 | 3.4E-04 |
| 30.0 | 1.020E+01 | 216.0 | 3.6E-04 | 1.5E-04 | 1.197E+01 | 226.5 | 3.8E-04 | 2.0E-04 |
| 35.0 | 4.701E+00 | 222.2 | 1.1E-04 | 9.2E-05 | 5.746E+00 | 236.5 | 1.6E-04 | 1.1E-04 |
| 40.0 | 2.243E+00 | 234.7 | 4.3E-05 | 4.1E-05 | 2.871E+00 | 253.4 | 6.7E-05 | 4.9E-05 |
| 45.0 | 1.113E+00 | 247.0 | 1.9E-05 | 1.3E-05 | 1.491E+00 | 264.2 | 3.2E-05 | 1.7E-05 |
| 50.0 | 5.719E-01 | 259.3 | 6.3E-06 | 4.3E-06 | 7.978E-01 | 270.6 | 1.2E-05 | 4.0E-06 |
| 70.0 | 4.016E-02 | 245.7 | 1.4E-07 | 8.6E-08 | 5.520E-02 | 219.7 | 1.5E-07 | 8.6E-08 |
| 100.0 | 3.000E-04 | 210.0 | 1.0E-09 | 4.3E-11 | 3.008E-04 | 210.0 | 1.0E-09 | 4.3E-11 |

RURAL

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| .200 | 1.91624 | .50286 | .250 | 1.85556 | .23174 | .300 | 1.67281 | .13351 |
| .337 | 1.53735 | .09620 | .400 | 1.31069 | .08337 | .488 | 1.06805 | .07050 |
| .515 | 1.00814 | .06748 | .550 | .93072 | .06928 | .633 | .79000 | .06159 |
| .694 | .70226 | .06129 | .860 | .51221 | .06694 | 1.060 | .38024 | .06779 |
| 1.300 | .26969 | .06247 | 1.536 | .20573 | .05907 | 1.800 | .15351 | .04432 |
| 2.000 | .13121 | .02763 | 2.250 | .11397 | .02494 | 2.500 | .10158 | .02938 |
| 2.700 | .07835 | .06559 | 3.000 | .08330 | .03696 | 3.200 | .09339 | .02046 |
| 3.392 | .09251 | .01379 | 3.500 | .09598 | .01583 | 3.750 | .09394 | .01157 |
| 4.000 | .09001 | .01465 | 4.500 | .08011 | .02219 | 5.000 | .07672 | .02033 |
| 5.500 | .06904 | .02455 | 6.000 | .05870 | .02921 | 6.200 | .05696 | .03113 |
| 6.500 | .05488 | .03354 | 7.200 | .05216 | .04713 | 7.900 | .03074 | .03904 |
| 8.200 | .01340 | .05110 | 8.500 | .03319 | .07937 | 8.700 | .05497 | .07125 |
| 9.000 | .05719 | .07649 | 9.200 | .05289 | .08719 | 9.500 | .05477 | .06358 |
| 9.800 | .05774 | .05266 | 10.000 | .05722 | .05123 | 10.591 | .05749 | .04301 |
| 11.000 | .05972 | .03687 | 11.500 | .05823 | .03386 | 12.500 | .05370 | .03269 |

| | | |
|---|---|---|
| 13.000 .05164 .03310 | 14.000 .04733 .03407 | 14.800 .03926 .03855 |
| 15.000 .03376 .05278 | 16.400 .04353 .04407 | 17.200 .04512 .04857 |
| 18.000 .04495 .04387 | 18.500 .04276 .04286 | 20.000 .04175 .04857 |
| 21.300 .03988 .04959 | 22.500 .03883 .04856 | 25.000 .03505 .04737 |
| 27.900 .03095 .04713 | 30.000 .02807 .04817 | 35.000 .02601 .04885 |
| 40.000 .02311 .04972 | | |

TROPOSPHERIC

| | | |
|---|---|---|
| .2002.03613 .50901 | .2501.96557 .21839 | .3001.76630 .11186 |
| .3371.61592 .07429 | .4001.36803 .06144 | .4881.10225 .04884 |
| .5151.03650 .04569 | .550 .95284 .04716 | .633 .79828 .03985 |
| .694 .70275 .03916 | .860 .49706 .04326 | 1.060 .35318 .04336 |
| 1.300 .23130 .03796 | 1.536 .16033 .03451 | 1.800 .09904 .02200 |
| 2.000 .06761 .01092 | 2.250 .05005 .01146 | 2.500 .03797 .01157 |
| 2.700 .02650 .03891 | 3.000 .02394 .01589 | 3.200 .02350 .00678 |
| 3.392 .02133 .00648 | 3.500 .02174 .00483 | 3.750 .01838 .00402 |
| 4.000 .01564 .00434 | 4.500 .01159 .00701 | 5.000 .00849 .00623 |
| 5.500 .00611 .00905 | 6.000 .00401 .01080 | 6.200 .00393 .01169 |
| 6.500 .00383 .01276 | 7.200 .00294 .02036 | 7.900 .00055 .01601 |
| 8.200 .00017 .02929 | 8.500 .00121 .04847 | 8.700 .00785 .03419 |
| 9.000 .00447 .03750 | 9.200 .00620 .04812 | 9.500 .00484 .02700 |
| 9.800 .00423 .01966 | 10.000 .00375 .01895 | 10.591 .00275 .01445 |
| 11.000 .00235 .01108 | 11.500 .00185 .01027 | 12.500 .00122 .00997 |
| 13.000 .00104 .01036 | 14.000 .00075 .01076 | 14.800 .00049 .01389 |
| 15.000 .00046 .02374 | 16.400 .00068 .01488 | 17.200 .00092 .01578 |
| 18.000 .00072 .01324 | 18.500 .00056 .01345 | 20.000 .00061 .01530 |
| 21.300 .00049 .01616 | 22.500 .00040 .01553 | 25.000 .00026 .01555 |
| 27.900 .00017 .01608 | 30.000 .00012 .01732 | 35.000 .00009 .01730 |
| 40.000 .00006 .01807 | | |

MARITIME

| | | |
|---|---|---|
| .2001.18545 .13003 | .2501.18060 .05471 | .3001.14150 .02800 |
| .3371.11526 .01958 | .4001.06260 .01536 | .4881.01394 .01221 |
| .515 .99745 .01147 | .550 .98821 .01179 | .633 .95556 .00996 |
| .694 .93959 .00979 | .860 .90128 .01084 | 1.060 .86617 .01210 |
| 1.360 .82883 .01178 | 1.536 .79507 .01207 | 1.800 .75342 .00918 |
| 2.000 .71594 .01389 | 2.250 .67716 .01062 | 2.500 .60927 .02125 |
| 2.700 .43992 .09134 | 3.000 .32712 .33275 | 3.200 .45940 .22077 |
| 3.392 .56701 .02004 | 3.500 .58489 .04164 | 3.750 .56451 .01718 |
| 4.000 .52889 .01985 | 4.500 .45201 .04247 | 5.000 .40717 .03660 |
| 5.500 .34309 .03207 | 6.000 .19835 .14879 | 6.200 .28863 .14478 |
| 6.500 .28792 .07387 | 7.200 .24147 .05965 | 7.900 .19876 .05840 |
| 8.200 .18694 .06368 | 8.500 .18482 .07119 | 8.700 .19956 .07051 |
| 9.000 .19546 .07085 | 9.200 .17855 .07218 | 9.500 .16085 .06397 |
| 9.800 .14392 .06222 | 10.000 .13066 .06245 | 10.591 .09447 .06893 |
| 11.000 .07216 .08415 | 11.500 .05652 .10523 | 12.500 .04623 .14900 |
| 13.000 .04841 .16294 | 14.000 .05448 .17892 | 14.800 .05801 .18318 |
| 15.000 .05950 .18658 | 16.400 .06689 .18760 | 17.200 .07504 .18580 |
| 18.000 .07611 .17950 | 18.500 .07484 .17523 | 20.000 .07033 .16056 |
| 21.300 .06514 .15090 | 22.500 .06128 .14325 | 25.000 .05367 .12993 |
| 27.900 .04611 .11930 | 30.000 .04085 .11231 | 35.000 .03006 .11187 |
| 40.000 .02533 .11364 | | |

URBAN

| | | |
|---|---|---|
| .2001.28721 .67671 | .2501.25108 .54737 | .3001.15409 .47917 |
| .3371.06510 .44168 | .400 .91714 .40356 | .488 .75674 .35914 |
| .515 .71667 .34824 | .550 .66572 .33428 | .633 .57055 .30266 |
| .694 .51096 .28660 | .860 .38284 .25454 | 1.060 .28960 .22559 |
| 1.300 .21311 .19640 | 1.536 .16700 .17528 | 1.800 .13019 .15242 |
| 2.000 .11288 .13387 | 2.250 .09833 .12404 | 2.500 .08758 .11565 |
| 2.700 .07286 .12876 | 3.000 .07209 .10754 | 3.200 .07572 .09346 |
| 3.392 .07383 .08966 | 3.500 .07500 .08610 | 3.750 .07258 .08063 |
| 4.000 .06939 .07739 | 4.500 .06220 .07474 | 5.000 .05900 .06824 |
| 5.500 .05386 .06613 | 6.000 .04767 .06472 | 6.200 .04634 .06492 |
| 6.500 .04496 .06393 | 7.200 .04271 .06784 | 7.900 .03118 .06030 |
| 8.200 .02199 .06560 | 8.500 .03205 .07916 | 8.700 .04318 .07416 |
| 9.000 .04414 .07610 | 9.200 .04181 .08090 | 9.500 .04262 .06802 |
| 9.800 .04400 .06101 | 10.000 .04365 .06037 | 10.591 .04350 .05493 |
| 11.000 .04448 .05040 | 11.500 .04350 .04842 | 12.500 .04083 .04604 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 13.000 | .03961 | .04562 | 14.000 | .03713 | .04476 | 14.800 | .03275 | .04621 |
| 15.000 | .02985 | .05336 | 16.400 | .03457 | .04751 | 17.200 | .03524 | .04911 |
| 18.000 | .03499 | .04595 | 18.500 | .03376 | .04505 | 20.000 | .03298 | .04691 |
| 21.300 | .03174 | .04672 | 22.500 | .03099 | .04552 | 25.000 | .02861 | .04374 |
| 27.900 | .02601 | .04246 | 30.000 | .02422 | .04226 | 35.000 | .02248 | .04112 |
| 40.000 | .02037 | .04028 | | | | | | |

BACKGROUND STRATOSPHERIC

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| .200 | 1.486730 | .00000 | .250 | 1.552710 | .00000 | .300 | 1.554620 | .00000 |
| .337 | 1.515090 | .00000 | .400 | 1.376140 | .00000 | .486 | 1.150490 | .00000 |
| .515 | 1.086510 | .00000 | .550 | 1.000000 | .00000 | .633 | .822440 | .00000 |
| .694 | .706310 | .00000 | .860 | .468510 | .00000 | 1.060 | .288640 | .00000 |
| 1.300 | .16420 | .00002 | 1.536 | .09972 | .00020 | 1.800 | .05817 | .00064 |
| 2.000 | .04055 | .00128 | 2.250 | .02570 | .00157 | 2.500 | .01560 | .00289 |
| 2.700 | .00931 | .00403 | 3.000 | .00632 | .05878 | 3.200 | .00600 | .07671 |
| 3.392 | .00627 | .08300 | 3.500 | .00623 | .07917 | 3.750 | .00510 | .08019 |
| 4.000 | .00403 | .05391 | 4.500 | .00242 | .04522 | 5.000 | .00145 | .04132 |
| 5.500 | .00103 | .05704 | 6.000 | .00105 | .05263 | 6.200 | .00080 | .04304 |
| 6.500 | .00055 | .05283 | 7.200 | .00019 | .04437 | 7.900 | .00050 | .11817 |
| 8.200 | .00077 | .14631 | 8.500 | .00095 | .14476 | 8.700 | .00096 | .12640 |
| 9.000 | .00072 | .09217 | 9.200 | .00058 | .06722 | 9.500 | .00071 | .09987 |
| 9.800 | .00067 | .07256 | 10.000 | .00049 | .04971 | 10.591 | .00027 | .04041 |
| 11.000 | .00026 | .05710 | 11.500 | .00026 | .03549 | 12.500 | .00013 | .01962 |
| 13.000 | .00010 | .01930 | 14.000 | .00007 | .01860 | 14.800 | .00005 | .01890 |
| 15.000 | .00005 | .01948 | 16.400 | .00004 | .03661 | 17.200 | .00005 | .04147 |
| 18.000 | .00005 | .02321 | 18.500 | .00004 | .01710 | 20.000 | .00002 | .01343 |
| 21.300 | .00002 | .01617 | 22.500 | .00002 | .01530 | 25.000 | .00001 | .00836 |
| 27.900 | .00001 | .00680 | 30.000 | .00001 | .00632 | 35.000 | .00000 | .00580 |
| 40.000 | .00000 | .00592 | | | | | | |

AGED VOLCANIC

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| .200 | .70064 | .44818 | .250 | .90085 | .28179 | .300 | 1.07908 | .11262 |
| .337 | 1.09515 | .08497 | .400 | 1.06762 | .07244 | .488 | 1.00303 | .05962 |
| .515 | .97994 | .05651 | .550 | .94729 | .05271 | .633 | .86756 | .04532 |
| .694 | .80787 | .04084 | .860 | .65695 | .03178 | 1.060 | .50565 | .02452 |
| 1.300 | .36931 | .01881 | 1.536 | .26480 | .01490 | 1.800 | .18488 | .01191 |
| 2.000 | .13533 | .01019 | 2.250 | .10205 | .00867 | 2.500 | .07792 | .00843 |
| 2.700 | .06343 | .00842 | 3.000 | .05126 | .00949 | 3.200 | .04262 | .00936 |
| 3.392 | .03761 | .00743 | 3.500 | .03439 | .00654 | 3.750 | .02913 | .00468 |
| 4.000 | .02394 | .00349 | 4.500 | .01775 | .00319 | 5.000 | .01204 | .00335 |
| 5.500 | .00969 | .00306 | 6.000 | .00570 | .00491 | 6.200 | .00467 | .00525 |
| 6.500 | .00378 | .00665 | 7.200 | .00260 | .01112 | 7.900 | .00136 | .01652 |
| 8.200 | .00099 | .02180 | 8.500 | .00257 | .02218 | 8.700 | .00481 | .02438 |
| 9.000 | .00602 | .02506 | 9.200 | .00573 | .02658 | 9.500 | .00518 | .02871 |
| 9.800 | .00475 | .02979 | 10.000 | .00449 | .03009 | 10.591 | .00322 | .02859 |
| 11.000 | .00260 | .02511 | 11.500 | .00191 | .02282 | 12.500 | .00090 | .01623 |
| 13.000 | .00071 | .01530 | 14.000 | .00048 | .01447 | 14.800 | .00033 | .01532 |
| 15.000 | .00032 | .01635 | 16.400 | .00029 | .01620 | 17.200 | .00029 | .01706 |
| 18.000 | .00031 | .01826 | 18.500 | .00031 | .01741 | 20.000 | .00026 | .01390 |
| 21.300 | .00023 | .01054 | 22.500 | .00020 | .01104 | 25.000 | .00014 | .01038 |
| 27.900 | .00008 | .01072 | 30.000 | .00006 | .01124 | 35.000 | .00003 | .01192 |
| 40.000 | .00007 | .01328 | | | | | | |

METEORIC DUST

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| .200 | 1.04956 | .00063 | .250 | 1.05670 | .00099 | .300 | 1.05726 | .00152 |
| .337 | 1.05076 | .00181 | .400 | 1.04063 | .00260 | .488 | 1.01617 | .00387 |
| .515 | 1.00724 | .00431 | .550 | .99434 | .00506 | .633 | .96565 | .00664 |
| .694 | .94158 | .00763 | .860 | .87556 | .01212 | 1.060 | .79629 | .01827 |
| 1.300 | .70574 | .02716 | 1.536 | .62325 | .03725 | 1.800 | .53895 | .04998 |
| 2.000 | .48221 | .06161 | 2.250 | .41598 | .07539 | 2.500 | .35737 | .08943 |
| 2.700 | .31622 | .10050 | 3.000 | .26452 | .11612 | 3.200 | .23667 | .12539 |
| 3.392 | .21466 | .13311 | 3.500 | .20421 | .13682 | 3.750 | .18453 | .14349 |
| 4.000 | .17001 | .14722 | 4.500 | .15088 | .14632 | 5.000 | .13775 | .13728 |
| 5.500 | .12619 | .12463 | 6.000 | .11435 | .11183 | 6.200 | .10943 | .10712 |
| 6.500 | .10177 | .10075 | 7.200 | .08264 | .09004 | 7.900 | .06170 | .08737 |
| 8.200 | .05237 | .08309 | 8.500 | .04325 | .09618 | 8.700 | .03775 | .10305 |
| 9.000 | .03151 | .11907 | 9.200 | .02962 | .13439 | 9.500 | .03129 | .16307 |
| 9.800 | .03697 | .18824 | 10.000 | .04059 | .19548 | 10.591 | .04385 | .20096 |
| 11.000 | .05296 | .22496 | 11.500 | .06557 | .18417 | 12.500 | .05590 | .09282 |
| 13.000 | .05084 | .08076 | 14.000 | .03968 | .07476 | 14.800 | .02937 | .06666 |
| 15.000 | .02633 | .06823 | 16.400 | .02245 | .12330 | 17.200 | .01822 | .10549 |
| 18.000 | .01767 | .13933 | 18.500 | .02167 | .16181 | 20.000 | .02886 | .13154 |
| 21.300 | .02356 | .09836 | 22.500 | .01847 | .10425 | 25.000 | .02339 | .10584 |
| 27.900 | .01851 | .07749 | 30.000 | .01783 | .06758 | 35.000 | .01360 | .03695 |
| 40.000 | .00864 | .03245 | | | | | | |

# Appendix B

## Extinction Coefficient Charts for Selected Laser Frequencies

Extinction Coefficients are provided for a selected list of the laser emission frequencies identified in Table 7. Results are provided for six geographical models and two aerosol models. The total extinction coefficient ($\gamma$) for a given atmospheric layer is determined by summing the four quantities $k_m$, $\sigma_m$, $k_a$ and $\sigma_a$ as indicated in Eq. (1) of this report. The units of all quantities are $km^{-1}$. Therefore, the total transmission for a horizontal path is obtained by application of Eq. (6) to the total extinction coefficient as obtained from the chart. For sea level conditions, if the Rural aerosol model is not appropriate to a specific application, results are provided at the bottom of each chart for three additional boundary layer aerosol models. However, it should be noted that results are not provided for the "Clear" (50 km Met. Range) Urban model as the model is simply not applicable to very clear situations. Similarly, results are not provided for the "Hazy" (5 km Met. Range) Tropospheric model as this model is not to be used under limited visibility conditions. It is suggested that linear interpolation be used to obtain extinction coefficients for Meteorological Ranges between 5 and 50 km.

For vertical or slant atmospheric paths, extinction coefficients can be obtained by summation of extinction coefficients in appropriate columns, excluding the first row of the chart. All values are provided in the unit, $km^{-1}$, and entires are made for each 1-km interval from the surface to 25-km altitude, thus reducing the problem to this simple summation. For altitudes above 25 km, it is necessary

to multiply the values read from the chart by the height increment corresponding to the layer. For slant path calculations, the total extinction value for the vertical path must be multiplied by the secant of the zenith angle before application of Eq. (7).

$$\tau = \exp\left[-\sec\theta \sum_{j} \gamma_j\right] \tag{7}$$

WAVELENGTH = 10.811103 MICROMETERS
FREQUENCY = 924.975 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$ | $\sigma_m$ | TROPICAL $\alpha_m$ | MIDLAT SUMMER $\alpha_m$ | MIDLAT WINTER $\alpha_m$ | SUBARCTIC SUMMER $\alpha_m$ | SUBARCTIC WINTER $\alpha_m$ | AEROSOL CLEAR $\alpha_a$ | CLEAR $\sigma_a$ | HAZY $\alpha_a$ | HAZY $\sigma_a$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.09E+00 | 0. | 3.95E+00 | 2.76E+00 | 5.35E-01 | 1.67E+00 | 1.50E-01 | 2.73E-03 | 4.03E-03 | 2.97E-02 | 4.44E-02 |
| 0 - 1 | 9.31E-01 | 0. | 3.33E+00 | 2.31E+00 | 4.66E-01 | 1.39E+00 | 1.61E-01 | 1.80E-03 | 2.70E-03 | 2.97E-02 | 4.44E-02 |
| 1 - 2 | 6.67E-01 | 0. | 2.39E+00 | 1.56E+00 | 3.53E-01 | 9.68E-01 | 1.57E-01 | 2.20E-04 | 4.41E-05 | 3.50E-03 | 7.03E-04 |
| 2 - 3 | 4.46E-01 | 0. | 1.51E+00 | 9.55E-01 | 2.59E-01 | 6.70E-01 | 1.26E-01 | 1.12E-04 | 2.26E-05 | 5.93E-04 | 1.19E-04 |
| 3 - 4 | 2.79E-01 | 0. | 7.61E-01 | 5.60E-01 | 1.64E-01 | 4.40E-01 | 6.74E-02 | 9.17E-05 | 1.84E-05 | 3.24E-04 | 6.51E-05 |
| 4 - 5 | 1.68E-01 | 0. | 4.25E-01 | 3.15E-01 | 9.34E-02 | 2.74E-01 | 4.88E-02 | 7.06E-05 | 1.42E-05 | 1.69E-04 | 3.39E-05 |
| 5 - 6 | 9.84E-02 | 0. | 2.67E-01 | 1.79E-01 | 5.33E-02 | 1.55E-01 | 2.40E-02 | 5.24E-05 | 1.05E-05 | 1.07E-04 | 2.15E-05 |
| 6 - 7 | 5.61E-02 | 0. | 1.49E-01 | 1.10E-01 | 2.62E-02 | 8.21E-02 | 1.24E-02 | 7.62E-05 | 7.28E-06 | 8.75E-05 | 1.76E-05 |
| 7 - 8 | 3.10E-02 | 0. | 7.97E-02 | 6.37E-02 | 1.12E-02 | 3.99E-02 | 4.85E-03 | 2.29E-05 | 4.60E-06 | 5.85E-05 | 1.18E-05 |
| 8 - 9 | 1.47E-02 | 0. | 4.00E-02 | 3.55E-02 | 5.22E-03 | 1.56E-02 | 2.13E-03 | 5.86E-05 | 0. | 6.69E-05 | 7.22E-06 |
| 9 - 10 | 5.90E-03 | 0. | 1.80E-02 | 1.91E-02 | 2.67E-03 | 5.62E-03 | 1.68E-03 | 4.36E-05 | 0. | 4.88E-05 | 5.27E-06 |
| 10 - 11 | 2.65E-03 | 0. | 7.25E-03 | 8.49E-03 | 1.88E-03 | 3.03E-03 | 1.39E-03 | 3.72E-05 | 0. | 5.28E-05 | 5.70E-06 |
| 11 - 12 | 1.50E-03 | 0. | 2.98E-03 | 3.12E-03 | 1.74E-03 | 2.34E-03 | 1.19E-03 | 3.41E-05 | 0. | 6.07E-05 | 6.56E-06 |
| 12 - 13 | 1.09E-03 | 0. | 1.44E-03 | 1.33E-03 | 1.29E-03 | 1.70E-03 | 1.05E-03 | 3.18E-05 | 0. | 6.99E-05 | 7.55E-06 |
| 13 - 14 | 9.04E-04 | 0. | 7.71E-04 | 8.92E-04 | 9.74E-04 | 1.38E-03 | 9.38E-04 | 3.14E-05 | 0. | 7.59E-05 | 8.19E-06 |
| 14 - 15 | 8.39E-04 | 0. | 5.23E-04 | 8.52E-04 | 8.88E-04 | 1.32E-03 | 8.76E-04 | 3.19E-05 | 0. | 7.75E-05 | 8.37E-06 |
| 15 - 16 | 8.19E-04 | 0. | 3.46E-04 | 8.03E-04 | 8.37E-04 | 1.22E-03 | 8.30E-04 | 3.18E-05 | 0. | 7.55E-05 | 8.15E-06 |
| 16 - 17 | 8.01E-04 | 0. | 2.45E-04 | 7.75E-04 | 7.96E-04 | 1.24E-03 | 7.90E-04 | 3.08E-05 | 0. | 6.93E-05 | 7.48E-06 |
| 17 - 18 | 7.89E-04 | 0. | 2.56E-04 | 7.69E-04 | 7.69E-04 | 1.22E-03 | 7.54E-04 | 2.88E-05 | 0. | 6.07E-05 | 6.55E-06 |
| 18 - 19 | 7.81E-04 | 0. | 3.23E-04 | 7.77E-04 | 7.36E-04 | 1.22E-03 | 7.23E-04 | 2.61E-05 | 0. | 5.07E-05 | 5.47E-06 |
| 19 - 20 | 7.76E-04 | 0. | 4.01E-04 | 8.15E-04 | 7.16E-04 | 1.22E-03 | 6.91E-04 | 2.26E-05 | 0. | 4.06E-05 | 4.39E-06 |
| 20 - 21 | 7.85E-04 | 0. | 5.09E-04 | 8.53E-04 | 7.24E-04 | 1.19E-03 | 6.66E-04 | 1.91E-05 | 0. | 3.24E-05 | 3.50E-06 |
| 21 - 22 | 8.38E-04 | 0. | 6.37E-04 | 9.03E-04 | 7.17E-04 | 1.20E-03 | 6.43E-04 | 1.60E-05 | 0. | 2.59E-05 | 2.80E-06 |
| 22 - 23 | 8.80E-04 | 0. | 7.39E-04 | 9.55E-04 | 7.12E-04 | 1.19E-03 | 6.19E-04 | 1.33E-05 | 0. | 2.02E-05 | 2.18E-06 |
| 23 - 24 | 9.26E-04 | 0. | 8.21E-04 | 1.07E-03 | 7.00E-04 | 1.22E-03 | 5.97E-04 | 1.07E-05 | 0. | 1.56E-05 | 1.69E-06 |
| 24 - 25 | 9.76E-04 | 0. | 9.23E-04 | 1.18E-03 | 7.33E-04 | 1.31E-03 | 5.77E-04 | 8.38E-06 | 0. | 1.23E-05 | 1.33E-06 |
| 25 - 30 | 1.07E-03 | 0. | 1.21E-03 | 1.38E-03 | 7.11E-04 | 1.55E-03 | 6.10E-04 | 1.66E-05 | 3.78E-06 | 4.24E-05 | 9.63E-06 |
| 30 - 35 | 1.02E-03 | 0. | 1.35E-03 | 1.53E-03 | 6.38E-04 | 2.41E-03 | 5.11E-04 | 5.11E-06 | 1.17E-06 | 9.74E-06 | 2.22E-06 |
| 35 - 40 | 1.19E-03 | 0. | 1.40E-03 | 1.67E-03 | 7.36E-04 | 1.89E-03 | 4.98E-04 | 2.51E-06 | 0. | 3.16E-06 | 0. |
| 40 - 45 | 1.17E-03 | 0. | 1.26E-03 | 1.58E-03 | 7.85E-04 | 1.54E-03 | 4.75E-04 | 1.24E-06 | 0. | 1.24E-06 | 0. |
| 45 - 50 | 8.74E-04 | 0. | 9.26E-04 | 1.22E-03 | 6.40E-04 | 1.35E-03 | 4.09E-04 | 0. | 0. | 0. | 0. |
| 50 - 70 | 1.04E-04 | 0. | 1.09E-04 | 1.33E-04 | 1.02E-04 | 1.35E-04 | 1.02E-04 | 0. | 0. | 0. | 0. |
| 70 -100 | 1.21E-06 | 0. | 1.25E-06 | 1.41E-06 | 1.39E-06 | 1.40E-06 | 1.75E-06 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$ | CLEAR $\sigma_a$ | HAZY $\alpha_a$ | HAZY $\sigma_a$ |
|---|---|---|---|---|
| URBAN | ******** | ******** | 3.97E-02 | 3.33E-02 |
| MARITIME | 5.37E-03 | 5.72E-03 | 5.85E-02 | 6.23E-02 |
| TROPOSPHERIC | 2.76E-04 | 1.76E-04 | ******** | ******** |

WAVELENGTH = 10.611386 MICROMETERS
FREQUENCY = 942.384 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.16E-01 | 0. | 4.66E-01 | 3.05E-01 | 7.05E-02 | 1.78E-01 | 3.53E-02 | 2.96E-03 | 4.00E-03 | 3.23E-02 | 4.36E-02 |
| 0 - 1 | 1.00E-01 | 0. | 3.55E-01 | 2.34E-01 | 6.23E-02 | 1.41E-01 | 3.59E-02 | 1.96E-03 | 2.65E-03 | 3.23E-02 | 4.36E-02 |
| 1 - 2 | 7.47E-02 | 0. | 2.21E-01 | 1.41E-01 | 5.04E-02 | 9.55E-02 | 3.44E-02 | 2.49E-04 | 4.76E-05 | 3.97E-03 | 7.58E-04 |
| 2 - 3 | 5.61E-02 | 0. | 1.26E-01 | 8.92E-02 | 4.19E-02 | 6.85E-02 | 3.02E-02 | 1.27E-04 | 2.44E-05 | 6.71E-04 | 1.28E-04 |
| 3 - 4 | 4.31E-02 | 0. | 7.36E-02 | 6.15E-02 | 3.42E-02 | 5.16E-02 | 2.58E-02 | 1.04E-04 | 1.99E-05 | 3.67E-04 | 7.02E-05 |
| 4 - 5 | 3.40E-02 | 0. | 5.34E-02 | 4.70E-02 | 2.75E-02 | 4.01E-02 | 2.09E-02 | 8.00E-05 | 1.53E-05 | 1.91E-04 | 3.65E-05 |
| 5 - 6 | 2.73E-02 | 0. | 4.27E-02 | 3.82E-02 | 2.25E-02 | 3.17E-02 | 1.65E-02 | 5.94E-05 | 1.14E-05 | 1.21E-04 | 2.31E-05 |
| 6 - 7 | 2.19E-02 | 0. | 3.42E-02 | 3.21E-02 | 1.83E-02 | 2.45E-02 | 1.29E-02 | 4.11E-05 | 7.85E-06 | 9.91E-05 | 1.89E-05 |
| 7 - 8 | 1.75E-02 | 0. | 2.74E-02 | 2.59E-02 | 1.48E-02 | 1.94E-02 | 9.97E-03 | 2.60E-05 | 4.95E-06 | 6.63E-05 | 1.27E-05 |
| 8 - 9 | 1.39E-02 | 0. | 2.25E-02 | 2.08E-02 | 1.19E-02 | 1.52E-02 | 8.16E-03 | 4.88E-05 | 0. | 7.12E-05 | 7.93E-06 |
| 9 - 10 | 1.09E-02 | 0. | 1.78E-02 | 1.68E-02 | 9.45E-03 | 1.18E-02 | 7.56E-03 | 3.63E-05 | 0. | 5.20E-05 | 5.83E-06 |
| 10 - 11 | 8.49E-03 | 0. | 1.42E-02 | 1.33E-02 | 8.30E-03 | 1.04E-02 | 7.57E-03 | 3.10E-05 | 0. | 5.62E-05 | 6.30E-06 |
| 11 - 12 | 7.41E-03 | 0. | 1.10E-02 | 1.05E-02 | 8.14E-03 | 1.03E-02 | 7.59E-03 | 2.84E-05 | 0. | 6.47E-05 | 7.26E-06 |
| 12 - 13 | 7.37E-03 | 0. | 8.82E-03 | 8.12E-03 | 7.98E-03 | 1.03E-02 | 7.56E-03 | 2.65E-05 | 0. | 7.45E-05 | 8.36E-06 |
| 13 - 14 | 7.37E-03 | 0. | 6.25E-03 | 7.16E-03 | 7.77E-03 | 1.04E-02 | 7.56E-03 | 2.61E-05 | 0. | 8.08E-05 | 9.07E-06 |
| 14 - 15 | 7.37E-03 | 0. | 4.92E-03 | 7.43E-03 | 7.65E-03 | 1.06E-02 | 7.59E-03 | 2.66E-05 | 0. | 8.25E-05 | 9.26E-06 |
| 15 - 16 | 7.37E-03 | 0. | 3.63E-03 | 7.21E-03 | 7.48E-03 | 9.99E-03 | 7.45E-03 | 2.65E-05 | 0. | 8.04E-05 | 9.02E-06 |
| 16 - 17 | 7.35E-03 | 0. | 2.76E-03 | 7.10E-03 | 7.30E-03 | 1.03E-02 | 7.28E-03 | 2.56E-05 | 0. | 7.38E-05 | 8.28E-06 |
| 17 - 18 | 7.36E-03 | 0. | 2.97E-03 | 7.16E-03 | 7.20E-03 | 1.03E-02 | 7.10E-03 | 2.40E-05 | 0. | 6.46E-05 | 7.25E-06 |
| 18 - 19 | 7.36E-03 | 0. | 3.64E-03 | 7.27E-03 | 7.00E-03 | 1.03E-02 | 6.92E-03 | 2.17E-05 | 0. | 5.39E-05 | 6.05E-06 |
| 19 - 20 | 7.35E-03 | 0. | 4.37E-03 | 7.60E-03 | 6.88E-03 | 1.04E-02 | 6.72E-03 | 1.88E-05 | 0. | 4.33E-05 | 4.86E-06 |
| 20 - 21 | 7.51E-03 | 0. | 5.31E-03 | 7.89E-03 | 7.00E-03 | 1.02E-02 | 6.56E-03 | 1.59E-05 | 0. | 3.45E-05 | 3.87E-06 |
| 21 - 22 | 7.83E-03 | 0. | 6.34E-03 | 8.28E-03 | 6.95E-03 | 1.03E-02 | 6.40E-03 | 1.33E-05 | 0. | 2.76E-05 | 3.09E-06 |
| 22 - 23 | 8.14E-03 | 0. | 7.11E-03 | 8.62E-03 | 6.93E-03 | 1.03E-02 | 6.23E-03 | 1.11E-05 | 0. | 2.15E-05 | 2.41E-06 |
| 23 - 24 | 8.48E-03 | 0. | 7.72E-03 | 9.49E-03 | 6.82E-03 | 1.05E-02 | 6.07E-03 | 9.87E-06 | 0. | 1.66E-05 | 1.86E-06 |
| 24 - 25 | 8.84E-03 | 0. | 8.48E-03 | 9.63E-03 | 7.16E-03 | 1.11E-02 | 5.92E-03 | 6.98E-06 | 0. | 1.31E-05 | 1.47E-06 |
| 25 - 30 | 9.47E-03 | 0. | 1.04E-02 | 1.15E-02 | 6.92E-03 | 1.25E-02 | 6.16E-03 | 1.57E-05 | 3.43E-06 | 4.01E-05 | 8.78E-06 |
| 30 - 35 | 8.51E-03 | 0. | 1.05E-02 | 1.16E-02 | 5.93E-03 | 1.76E-02 | 4.98E-03 | 4.83E-06 | 1.06E-06 | 9.20E-06 | 2.02E-06 |
| 35 - 40 | 8.64E-03 | 0. | 9.80E-03 | 1.13E-02 | 5.94E-03 | 1.25E-02 | 4.37E-03 | 2.37E-06 | 0. | 2.96E-06 | 0. |
| 40 - 45 | 7.48E-03 | 0. | 7.99E-03 | 9.59E-03 | 5.41E-03 | 1.08E-02 | 3.64E-03 | 1.17E-06 | 0. | 1.17E-06 | 0. |
| 45 - 50 | 5.17E-03 | 0. | 5.47E-03 | 6.87E-03 | 3.98E-03 | 7.42E-03 | 2.77E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 7.68E-04 | 0. | 8.04E-04 | 9.63E-04 | 7.28E-04 | 9.81E-04 | 6.98E-04 | 0. | 0. | 0. | 0. |
| 70 -100 | 1.29E-05 | 0. | 1.33E-05 | 1.51E-05 | 1.37E-05 | 1.53E-05 | 1.57E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 4.14E-02 | 3.30E-02 |
| MARITIME | 4.85E-03 | 6.49E-03 | 5.28E-02 | 7.06E-02 |
| TROPOSPHERIC | 9.92E-04 | 1.90E-04 | ******** | ******** |

WAVELENGTH = 10.591033 MICROMETERS
FREQUENCY = 944.195 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.25E-01 | 0. | 4.80E-01 | 3.19E-01 | 7.58E-02 | 1.83E-01 | 3.86E-02 | 2.99E-03 | 4.00E-03 | 3.26E-02 | 4.35E-02 |
| 0 - 1 | 1.04E-01 | 0. | 3.71E-01 | 2.46E-01 | 6.73E-02 | 1.50E-01 | 3.92E-02 | 1.98E-03 | 2.64E-03 | 3.26E-02 | 4.35E-02 |
| 1 - 2 | 8.07E-02 | 0. | 2.32E-01 | 1.50E-01 | 5.47E-02 | 1.02E-01 | 3.77E-02 | 2.52E-04 | 4.80E-05 | 4.82E-03 | 7.64E-04 |
| 2 - 3 | 6.10E-02 | 0 | 1.34E-01 | 9.59E-02 | 4.57E-02 | 7.37E-02 | 3.32E-02 | 1.29E-04 | 2.45E-05 | 6.79E-04 | 1.29E-04 |
| 3 - 4 | 4.71E-02 | 0. | 7.97E-02 | 6.69E-02 | 3.75E-02 | 5.60E-02 | 2.85E-02 | 1.05E-04 | 2.00E-05 | 3.72E-04 | 7.07E-05 |
| 4 - 5 | 3.74E-02 | 0. | 5.83E-02 | 5.14E-02 | 3.05E-02 | 4.39E-02 | 2.32E-02 | 8.10E-05 | 1.54E-05 | 1.93E-04 | 3.68E-05 |
| 5 - 6 | 3.01E-02 | 0. | 4.68E-02 | 4.20E-02 | 2.49E-02 | 3.49E-02 | 1.84E-02 | 6.01E-05 | 1.14E-05 | 1.23E-04 | 2.33E-05 |
| 6 - 7 | 2.43E-02 | 0. | 3.76E-02 | 3.54E-02 | 2.03E-02 | 2.71E-02 | 1.44E-02 | 4.16E-05 | 7.91E-06 | 1.00E-04 | 1.91E-05 |
| 7 - 8 | 1.96E-02 | 0. | 3.03E-02 | 2.88E-02 | 1.65E-02 | 2.16E-02 | 1.12E-02 | 2.63E-05 | 5.00E-06 | 6.71E-05 | 1.28E-05 |
| 8 - 9 | 1.56E-02 | 0. | 2.50E-02 | 2.31E-02 | 1.34E-02 | 1.70E-02 | 9.23E-03 | 4.78E-05 | 0. | 7.16E-05 | 8.07E-06 |
| 9 - 10 | 1.23E-02 | 0. | 1.99E-02 | 1.88E-02 | 1.06E-02 | 1.32E-02 | 8.58E-03 | 3.56E-05 | 0. | 5.23E-05 | 5.89E-06 |
| 10 - 11 | 9.58E-03 | 0. | 1.59E-02 | 1.49E-02 | 9.37E-03 | 1.17E-02 | 8.56E-03 | 3.03E-05 | 0. | 5.65E-05 | 6.37E-06 |
| 11 - 12 | 9.34E-03 | 0. | 1.24E-02 | 1.18E-02 | 9.19E-03 | 1.16E-02 | 8.59E-03 | 2.76E-05 | 0. | 6.51E-05 | 7.33E-06 |
| 12 - 13 | 8.34E-03 | 0. | 9.94E-03 | 9.17E-03 | 9.01E-03 | 1.16E-02 | 8.54E-03 | 2.60E-05 | 0. | 7.49E-05 | 8.44E-06 |
| 13 - 14 | 8.33E-03 | 0. | 7.09E-03 | 8.11E-03 | 8.77E-03 | 1.17E-02 | 8.54E-03 | 2.56E-05 | 0. | 8.13E-05 | 9.16E-06 |
| 14 - 15 | 8.33E-03 | 0. | 5.61E-03 | 6.41E-03 | 8.64E-03 | 1.19E-02 | 8.57E-03 | 2.60E-05 | 0. | 8.31E-05 | 9.35E-06 |
| 15 - 16 | 8.32E-03 | 0. | 4.16E-03 | 8.15E-03 | 8.44E-03 | 1.12E-02 | 8.41E-03 | 2.59E-05 | 0. | 8.09E-05 | 9.11E-06 |
| 16 - 17 | 8.29E-03 | 0. | 3.19E-03 | 8.02E-03 | 8.24E-03 | 1.16E-02 | 8.22E-03 | 2.51E-05 | 0. | 7.43E-05 | 8.36E-06 |
| 17 - 18 | 8.30E-03 | 0. | 3.41E-03 | 8.08E-03 | 8.13E-03 | 1.15E-02 | 8.01E-03 | 2.35E-05 | 0. | 6.50E-05 | 7.33E-06 |
| 18 - 19 | 8.29E-03 | 0. | 4.17E-03 | 8.19E-03 | 7.89E-03 | 1.15E-02 | 7.81E-03 | 2.13E-05 | 0. | 5.43E-05 | 6.11E-06 |
| 19 - 20 | 8.28E-03 | 0. | 4.93E-03 | 8.55E-03 | 7.76E-03 | 1.16E-02 | 7.59E-03 | 1.85E-05 | 0. | 4.35E-05 | 4.90E-06 |
| 20 - 21 | 8.44E-03 | 0. | 6.02E-03 | 8.87E-03 | 7.88E-03 | 1.14E-02 | 7.40E-03 | 1.56E-05 | 0. | 3.47E-05 | 3.91E-06 |
| 21 - 22 | 8.75E-03 | 0. | 7.16E-03 | 9.29E-03 | 7.83E-03 | 1.15E-02 | 7.22E-03 | 1.31E-05 | 0. | 2.77E-05 | 3.12E-06 |
| 22 - 23 | 9.13E-03 | 0. | 8.10E-03 | 9.65E-03 | 7.80E-03 | 1.15E-02 | 7.03E-03 | 1.08E-05 | 0. | 2.16E-05 | 2.43E-06 |
| 23 - 24 | 9.50E-03 | 0. | 8.66E-03 | 1.06E-02 | 7.68E-03 | 1.17E-02 | 6.85E-03 | 8.69E-06 | 0. | 1.67E-05 | 1.88E-06 |
| 24 - 25 | 9.88E-03 | 0. | 9.49E-03 | 1.07E-02 | 8.06E-03 | 1.23E-02 | 6.68E-03 | 6.84E-06 | 0. | 1.32E-05 | 1.48E-06 |
| 25 - 30 | 1.05E-02 | 0. | 1.15E-02 | 1.27E-02 | 7.77E-03 | 1.35E-02 | 6.94E-03 | 1.56E-05 | 3.40E-06 | 3.98E-05 | 8.63E-06 |
| 30 - 35 | 9.47E-03 | 0. | 1.16E-02 | 1.28E-02 | 6.66E-03 | 1.93E-02 | 5.60E-03 | 4.60E-06 | 1.05E-06 | 9.14E-06 | 1.99E-06 |
| 35 - 40 | 9.53E-03 | 0. | 1.08E-02 | 1.24E-02 | 6.61E-03 | 1.36E-02 | 4.89E-03 | 2.36E-06 | 0. | 2.96E-06 | 0. |
| 40 - 45 | 8.14E-03 | 0. | 8.73E-03 | 1.04E-02 | 5.96E-03 | 1.17E-02 | 4.04E-03 | 1.16E-06 | 0. | 1.16E-06 | 0. |
| 45 - 50 | 5.63E-03 | 0. | 5.95E-03 | 7.45E-03 | 4.34E-03 | 8.03E-03 | 3.04E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 8.50E-04 | 0. | 9.91E-04 | 1.06E-03 | 8.03E-04 | 1.03E-03 | 7.68E-04 | 0. | 0. | 0. | 0. |
| 70 -100 | 1.47E-05 | 0. | 1.52E-05 | 1.73E-05 | 1.56E-05 | 1.74E-05 | 1.77E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 4.16E-02 | 3.29E-02 |
| MARITIME | 4.79E-03 | 6.57E-03 | 5.22E-02 | 7.15E-02 |
| TROPOSPHERIC | 1.00E-03 | 1.91E-04 | ******** | ******** |

WAVELENGTH = 10.571337 MICROMETERS
FREQUENCY = 945.981 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.24E-01 | 0. | 4.68E-01 | 3.13E-01 | 7.64E-02 | 1.86E-01 | 3.98E-02 | 3.01E-03 | 3.99E-03 | 3.28E-02 | 4.35E-02 |
| 0 - 1 | 1.07E-01 | 0. | 3.63E-01 | 2.41E-01 | 6.81E-02 | 1.48E-01 | 4.04E-02 | 1.99E-03 | 2.64E-03 | 3.28E-02 | 4.35E-02 |
| 1 - 2 | 8.10E-02 | 0. | 2.28E-01 | 1.48E-01 | 5.57E-02 | 1.02E-01 | 3.89E-02 | 2.55E-04 | 4.85E-05 | 4.06E-03 | 7.73E-04 |
| 2 - 3 | 6.18E-02 | 0. | 1.33E-01 | 9.58E-02 | 4.68E-02 | 7.43E-02 | 3.44E-02 | 1.30E-04 | 2.48E-05 | 6.86E-04 | 1.31E-04 |
| 3 - 4 | 4.82E-02 | 0. | 8.00E-02 | 6.75E-02 | 3.87E-02 | 5.69E-02 | 2.96E-02 | 1.06E-04 | 2.02E-05 | 3.75E-04 | 7.15E-05 |
| 4 - 5 | 3.85E-02 | 0. | 5.92E-02 | 5.24E-02 | 3.16E-02 | 4.49E-02 | 2.43E-02 | 8.18E-05 | 1.56E-05 | 1.95E-04 | 3.72E-05 |
| 5 - 6 | 3.12E-02 | 0. | 4.79E-02 | 4.31E-02 | 2.60E-02 | 3.60E-02 | 1.94E-02 | 6.07E-05 | 1.16E-05 | 1.24E-04 | 2.36E-05 |
| 6 - 7 | 2.54E-02 | 0. | 3.88E-02 | 3.65E-02 | 2.14E-02 | 2.83E-02 | 1.53E-02 | 4.20E-05 | 8.00E-06 | 1.01E-04 | 1.93E-05 |
| 7 - 8 | 2.06E-02 | 0. | 3.14E-02 | 2.98E-02 | 1.75E-02 | 2.26E-02 | 1.20E-02 | 2.65E-05 | 5.06E-06 | 6.78E-05 | 1.29E-05 |
| 8 - 9 | 1.65E-02 | 0. | 2.61E-02 | 2.42E-02 | 1.42E-02 | 1.80E-02 | 9.93E-03 | 4.81E-05 | 0. | 7.18E-05 | 8.17E-06 |
| 9 - 10 | 1.31E-02 | 0. | 2.09E-02 | 1.98E-02 | 1.14E-02 | 1.41E-02 | 9.25E-03 | 3.58E-05 | 0. | 5.24E-05 | 5.97E-06 |
| 10 - 11 | 1.03E-02 | 0. | 1.69E-02 | 1.58E-02 | 1.01E-02 | 1.25E-02 | 9.24E-03 | 3.05E-05 | 0. | 5.66E-05 | 6.45E-06 |
| 11 - 12 | 9.05E-03 | 0. | 1.32E-02 | 1.26E-02 | 9.90E-03 | 1.24E-02 | 9.27E-03 | 2.80E-05 | 0. | 6.52E-05 | 7.42E-06 |
| 12 - 13 | 9.01E-03 | 0. | 1.07E-02 | 9.87E-03 | 9.71E-03 | 1.24E-02 | 9.22E-03 | 2.61E-05 | 0. | 7.51E-05 | 8.55E-06 |
| 13 - 14 | 9.01E-03 | 0. | 7.69E-03 | 8.76E-03 | 9.47E-03 | 1.25E-02 | 9.23E-03 | 2.58E-05 | 0. | 8.15E-05 | 9.28E-06 |
| 14 - 15 | 9.01E-03 | 0. | 6.13E-03 | 9.09E-03 | 9.33E-03 | 1.27E-02 | 9.27E-03 | 2.62E-05 | 0. | 8.32E-05 | 9.47E-06 |
| 15 - 16 | 9.00E-03 | 0. | 4.58E-03 | 8.82E-03 | 9.13E-03 | 1.28E-02 | 9.19E-03 | 2.61E-05 | 0. | 8.10E-05 | 9.22E-06 |
| 16 - 17 | 8.98E-03 | 0. | 3.53E-03 | 8.69E-03 | 8.92E-03 | 1.24E-02 | 8.90E-03 | 2.53E-05 | 0. | 7.44E-05 | 8.47E-06 |
| 17 - 18 | 8.99E-03 | 0. | 3.78E-03 | 8.76E-03 | 8.81E-03 | 1.24E-02 | 8.69E-03 | 2.37E-05 | 0. | 6.52E-05 | 7.42E-06 |
| 18 - 19 | 8.99E-03 | 0. | 4.60E-03 | 8.88E-03 | 8.57E-03 | 1.24E-02 | 8.49E-03 | 2.14E-05 | 0. | 5.44E-05 | 6.19E-06 |
| 19 - 20 | 8.98E-03 | 0. | 5.47E-03 | 9.27E-03 | 8.43E-03 | 1.25E-02 | 8.25E-03 | 1.86E-05 | 0. | 4.35E-05 | 4.97E-06 |
| 20 - 21 | 9.16E-03 | 0. | 6.59E-03 | 9.61E-03 | 8.57E-03 | 1.23E-02 | 8.05E-03 | 1.57E-05 | 0. | 3.48E-05 | 3.96E-06 |
| 21 - 22 | 9.54E-03 | 0. | 7.80E-03 | 1.01E-02 | 8.52E-03 | 1.24E-02 | 7.87E-03 | 1.32E-05 | 0. | 2.78E-05 | 3.16E-06 |
| 22 - 23 | 9.89E-03 | 0. | 8.69E-03 | 1.04E-02 | 8.48E-03 | 1.24E-02 | 7.67E-03 | 1.09E-05 | 0. | 2.16E-05 | 2.46E-06 |
| 23 - 24 | 1.03E-02 | 0. | 9.40E-03 | 1.15E-02 | 8.35E-03 | 1.26E-02 | 7.48E-03 | 8.75E-06 | 0. | 1.67E-05 | 1.91E-06 |
| 24 - 25 | 1.07E-02 | 0. | 1.03E-02 | 1.16E-02 | 8.77E-03 | 1.33E-02 | 7.30E-03 | 6.89E-06 | 0. | 1.32E-05 | 1.50E-06 |
| 25 - 30 | 1.14E-02 | 0. | 1.24E-02 | 1.37E-02 | 8.45E-03 | 1.49E-02 | 7.57E-03 | 1.56E-05 | 3.39E-06 | 3.98E-05 | 8.67E-06 |
| 30 - 35 | 1.02E-02 | 0. | 1.24E-02 | 1.37E-02 | 7.24E-03 | 2.06E-02 | 6.12E-03 | 4.80E-06 | 1.04E-06 | 9.13E-06 | 1.99E-06 |
| 35 - 40 | 1.02E-02 | 0. | 1.15E-02 | 1.33E-02 | 7.13E-03 | 1.45E-02 | 5.31E-03 | 2.36E-06 | 0. | 2.96E-06 | 0. |
| 40 - 45 | 8.69E-03 | 0. | 9.28E-03 | 1.11E-02 | 6.37E-03 | 1.24E-02 | 4.35E-03 | 1.16E-06 | 0. | 1.16E-06 | 0. |
| 45 - 50 | 5.96E-03 | 0. | 6.30E-03 | 7.85E-03 | 4.61E-03 | 8.46E-03 | 3.25E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 9.14E-04 | 0. | 9.58E-04 | 1.14E-03 | 8.62E-04 | 1.16E-03 | 8.22E-04 | 0. | 0. | 0. | 0. |
| 70 -100 | 1.62E-05 | 0. | 1.68E-05 | 1.91E-05 | 1.71E-05 | 1.93E-05 | 1.93E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 4.17E-02 | 3.29E-02 |
| MARITIME | 4.78E-03 | 6.65E-03 | 5.20E-02 | 7.24E-02 |
| TROPOSPHERIC | 1.01E-03 | 1.93E-04 | ******** | ******** |

WAVELENGTH = 10.591384 MICROMETERS
FREQUENCY = 947.743 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.38E-01 | 0. | 5.23E-01 | 3.49E-01 | 3.37E-02 | 2.07E-01 | 4.26E-02 | 7.03E-03 | 3.99E-03 | 3.30E-02 | 4.35E-02 |
| 0 - 1 | 1.18E-01 | 0. | 4.04E-01 | 2.69E-01 | 7.40E-02 | 1.64E-01 | 4.31E-02 | 2.00E-03 | 2.64E-03 | 3.30E-02 | 4.35E-02 |
| 1 - 2 | 8.70E-02 | 0. | 2.52E-01 | 1.64E-01 | 5.97E-02 | 1.11E-01 | 4.12E-02 | 7.57E-04 | 4.91E-05 | 4.09E-03 | 7.82E-04 |
| 2 - 3 | 6.61E-02 | 0. | 1.45E-01 | 1.04E-01 | 4.97E-02 | 8.01E-02 | 3.63E-02 | 1.31E-04 | 2.51E-05 | 6.93E-04 | 1.32E-04 |
| 3 - 4 | 5.09E-02 | 0. | 8.57E-02 | 7.19E-02 | 4.07E-02 | 6.05E-02 | 3.12E-02 | 1.07E-04 | 2.05E-05 | 3.79E-04 | 7.24E-05 |
| 4 - 5 | 4.05E-02 | 0. | 6.24E-02 | 5.51E-02 | 3.31E-02 | 4.73E-02 | 2.56E-02 | 8.26E-05 | 1.59E-05 | 1.97E-04 | 3.76E-05 |
| 5 - 6 | 3.27E-02 | 0. | 5.02E-02 | 4.50E-02 | 2.73E-02 | 3.78E-02 | 2.04E-02 | 6.13E-05 | 1.17E-05 | 1.25E-04 | 2.39E-05 |
| 6 - 7 | 2.66E-02 | 0. | 4.05E-02 | 3.81E-02 | 2.25E-02 | 2.96E-02 | 1.62E-02 | 4.24E-05 | 8.09E-06 | 1.02E-04 | 1.95E-05 |
| 7 - 8 | 2.17E-02 | 0. | 3.28E-02 | 3.11E-02 | 1.85E-02 | 2.38E-02 | 1.24E-02 | 2.68E-05 | 5.12E-06 | 6.84E-05 | 1.31E-05 |
| 8 - 9 | 1.74E-02 | 0. | 2.73E-02 | 2.54E-02 | 1.51E-02 | 1.89E-02 | 1.06E-02 | 4.85E-05 | 0. | 7.19E-05 | 8.27E-06 |
| 9 - 10 | 1.39E-02 | 0. | 2.19E-02 | 2.08E-02 | 1.21E-02 | 1.49E-02 | 9.87E-03 | 3.61E-05 | 0. | 5.25E-05 | 6.04E-06 |
| 10 - 11 | 1.10E-02 | 0. | 1.78E-02 | 1.67E-02 | 1.07E-02 | 1.32E-02 | 9.66E-03 | 3.07E-05 | 0. | 5.67E-05 | 6.53E-06 |
| 11 - 12 | 9.66E-03 | 0. | 1.40E-02 | 1.34E-02 | 1.06E-02 | 1.32E-02 | 9.89E-03 | 2.82E-05 | 0. | 6.53E-05 | 7.51E-06 |
| 12 - 13 | 9.62E-03 | 0. | 1.14E-02 | 1.05E-02 | 1.04E-02 | 1.31E-02 | 9.84E-03 | 2.63E-05 | 0. | 7.52E-05 | 8.65E-06 |
| 13 - 14 | 9.62E-03 | 0. | 9.23E-03 | 9.36E-03 | 1.01E-02 | 1.32E-02 | 9.86E-03 | 2.60E-05 | 0. | 8.16E-05 | 9.39E-06 |
| 14 - 15 | 9.62E-03 | 0. | 6.60E-03 | 9.71E-03 | 9.96E-03 | 1.35E-02 | 9.89E-03 | 2.64E-05 | 0. | 8.33E-05 | 9.59E-06 |
| 15 - 16 | 9.61E-03 | 0. | 4.97E-03 | 9.42E-03 | 9.75E-03 | 1.27E-02 | 9.71E-03 | 2.63E-05 | 0. | 8.12E-05 | 9.34E-06 |
| 16 - 17 | 9.59E-03 | 0. | 3.84E-03 | 9.28E-03 | 9.53E-03 | 1.32E-02 | 9.51E-03 | 2.55E-05 | 0. | 7.45E-05 | 8.57E-06 |
| 17 - 18 | 9.60E-03 | 0. | 4.11E-03 | 9.36E-03 | 9.41E-03 | 1.31E-02 | 9.24E-03 | 2.39E-05 | 0. | 6.53E-05 | 7.51E-06 |
| 18 - 19 | 9.60E-03 | 0. | 4.98E-03 | 9.48E-03 | 9.16E-03 | 1.32E-02 | 9.07E-03 | 2.16E-05 | 0. | 5.45E-05 | 6.27E-06 |
| 19 - 20 | 9.59E-03 | 0. | 5.90E-03 | 9.89E-03 | 9.01E-03 | 1.33E-02 | 8.93E-03 | 1.87E-05 | 0. | 4.37E-05 | 5.03E-06 |
| 20 - 21 | 9.78E-03 | 0. | 7.68E-03 | 1.02E-02 | 9.16E-03 | 1.30E-02 | 8.62E-03 | 1.58E-05 | 0. | 3.49E-05 | 4.01E-06 |
| 21 - 22 | 1.02E-02 | 0. | 8.35E-03 | 1.07E-02 | 9.11E-03 | 1.31E-02 | 8.43E-03 | 1.33E-05 | 0. | 2.75E-05 | 3.20E-06 |
| 22 - 23 | 1.05E-02 | 0. | 9.29E-03 | 1.11E-02 | 9.07E-03 | 1.31E-02 | 8.22E-03 | 1.10E-05 | 0. | 2.17E-05 | 2.49E-06 |
| 23 - 24 | 1.10E-02 | 0. | 1.00E-02 | 1.22E-02 | 8.93E-03 | 1.33E-02 | 8.02E-03 | 8.81E-06 | 0. | 1.68E-05 | 1.93E-06 |
| 24 - 25 | 1.14E-02 | 0. | 1.10E-02 | 1.23E-02 | 9.38E-03 | 1.41E-02 | 7.83E-03 | 6.94E-06 | 0. | 1.32E-05 | 1.52E-06 |
| 25 - 30 | 1.21E-02 | 0. | 1.32E-02 | 1.45E-02 | 9.03E-03 | 1.57E-02 | 8.11E-03 | 1.55E-05 | 3.38E-06 | 3.98E-05 | 8.65E-06 |
| 30 - 35 | 1.08E-02 | 0. | 1.31E-02 | 1.44E-02 | 7.69E-03 | 2.16E-02 | 6.52E-03 | 4.79E-06 | 1.04E-06 | 9.13E-06 | 1.99E-06 |
| 35 - 40 | 1.07E-02 | 0. | 1.20E-02 | 1.38E-02 | 7.50E-03 | 1.51E-02 | 5.61E-03 | 2.36E-06 | 0. | 2.96E-06 | 0. |
| 40 - 45 | 9.00E-03 | 0. | 9.60E-03 | 1.14E-02 | 6.62E-03 | 1.27E-02 | 4.56E-03 | 1.16E-06 | 0. | 1.16E-06 | 0. |
| 45 - 50 | 6.13E-03 | 0. | 6.49E-03 | 8.07E-03 | 4.77E-03 | 8.67E-03 | 3.38E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 9.54E-04 | 0. | 1.00E-03 | 1.19E-03 | 8.98E-04 | 1.21E-03 | 8.53E-04 | 0. | 0. | 0. | 0. |
| 70 -100 | 1.73E-05 | 0. | 1.79E-05 | 2.04E-05 | 1.81E-05 | 2.06E-05 | 2.04E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 4.18E-02 | 3.29E-02 |
| MARITIME | 4.76E-03 | 6.73E-03 | 5.19E-02 | 7.33E-02 |
| TROPOSPHERIC | 1.02E-03 | 1.96E-04 | ******** | ******** |

WAVELENGTH = 10.423257 MICROMETERS
FREQUENCY = 959.393 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | CLEAR $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 7.42E-02 | 0. | 4.32E-01 | 2.69E-01 | 3.85E-02 | 1.40E-01 | 1.33E-02 | 3.14E-03 | 3.99E-03 | 3.43E-02 | 4.35E-02 |
| 0 - 1 | 5.92E-02 | 0. | 3.21E-01 | 1.95E-01 | 3.15E-02 | 1.03E-01 | 1.33E-02 | 2.08E-03 | 2.64E-03 | 3.43E-02 | 4.35E-02 |
| 1 - 2 | 3.77E-02 | 0. | 1.82E-01 | 1.01E-01 | 2.18E-02 | 5.88E-02 | 1.21E-02 | 2.73E-04 | 5.27E-05 | 4.36E-03 | 8.49E-04 |
| 2 - 3 | 2.36E-02 | 0. | 8.52E-02 | 4.92E-02 | 1.56E-02 | 3.52E-02 | 9.90E-03 | 1.40E-04 | 2.70E-05 | 7.37E-04 | 1.42E-04 |
| 3 - 4 | 1.52E-02 | 0. | 3.40E-02 | 2.58E-02 | 1.10E-02 | 2.14E-02 | 7.89E-03 | 1.14E-04 | 2.20E-05 | 4.03E-04 | 7.77E-05 |
| 4 - 5 | 1.06E-02 | 0. | 1.93E-02 | 1.57E-02 | 8.13E-03 | 1.39E-02 | 6.12E-03 | 8.78E-05 | 1.69E-05 | 2.10E-04 | 4.04E-05 |
| 5 - 6 | 7.99E-03 | 0. | 1.35E-02 | 1.12E-02 | 6.42E-03 | 9.70E-03 | 4.78E-03 | 6.52E-05 | 1.26E-05 | 1.33E-04 | 2.56E-05 |
| 6 - 7 | 6.27E-03 | 0. | 9.63E-03 | 8.9EE-03 | 5.19E-03 | 7.10E-03 | 3.80E-03 | 4.51E-05 | 8.69E-06 | 1.09E-04 | 2.10E-05 |
| 7 - 8 | 5.04E-03 | 0. | 7.59E-03 | 7.13E-03 | 4.26E-03 | 5.52E-03 | 3.02E-03 | 2.85E-05 | 5.50E-06 | 7.28E-05 | 1.40E-05 |
| 8 - 9 | 4.05E-03 | 0. | 6.20E-03 | 5.79E-03 | 3.51E-03 | 4.37E-03 | 2.54E-03 | 5.08E-05 | 0. | 7.27E-05 | 8.93E-06 |
| 9 - 10 | 3.26E-03 | 0. | 4.99E-03 | 4.76E-03 | 2.87E-03 | 3.48E-03 | 2.38E-03 | 3.78E-05 | 0. | 5.31E-05 | 6.53E-06 |
| 10 - 11 | 2.62E-03 | 0. | 4.09E-03 | 3.85E-03 | 2.57E-03 | 3.11E-03 | 2.37E-03 | 3.22E-05 | 0. | 5.73E-05 | 7.05E-06 |
| 11 - 12 | 2.33E-03 | 0. | 3.26E-03 | 3.14E-03 | 2.52E-03 | 3.03E-03 | 2.38E-03 | 2.96E-05 | 0. | 6.60E-05 | 8.11E-06 |
| 12 - 13 | 2.32E-03 | 0. | 2.71E-03 | 2.52E-03 | 2.48E-03 | 3.03E-03 | 2.36E-03 | 2.76E-05 | 0. | 7.60E-05 | 9.35E-06 |
| 13 - 14 | 2.31E-03 | 0. | 2.00E-03 | 2.26E-03 | 2.42E-03 | 3.11E-03 | 2.36E-03 | 2.72E-05 | 0. | 8.25E-05 | 1.01E-05 |
| 14 - 15 | 2.31E-03 | 0. | 1.64E-03 | 2.34E-03 | 2.39E-03 | 3.17E-03 | 2.37E-03 | 2.77E-05 | 0. | 8.42E-05 | 1.04E-05 |
| 15 - 16 | 2.31E-03 | 0. | 1.26E-03 | 2.27E-03 | 2.34E-03 | 2.99E-03 | 2.33E-03 | 2.76E-05 | 0. | 8.20E-05 | 1.01E-05 |
| 16 - 17 | 2.30E-03 | 0. | 9.92E-04 | 2.23E-03 | 2.29E-03 | 3.09E-03 | 2.28E-03 | 2.67E-05 | 0. | 7.53E-05 | 9.26E-06 |
| 17 - 18 | 2.30E-03 | 0. | 1.06E-03 | 2.25E-03 | 2.26E-03 | 3.07E-03 | 2.23E-03 | 2.59E-05 | 0. | 6.60E-05 | 8.11E-06 |
| 18 - 19 | 2.30E-03 | 0. | 1.26E-03 | 2.28E-03 | 2.20E-03 | 3.08E-03 | 2.18E-03 | 2.26E-05 | 0. | 5.50E-05 | 6.77E-06 |
| 19 - 20 | 2.30E-03 | 0. | 1.47E-03 | 2.36E-03 | 2.17E-03 | 3.10E-03 | 2.13E-03 | 1.96E-05 | 0. | 4.42E-05 | 5.43E-06 |
| 20 - 21 | 2.34E-03 | 0. | 1.74E-03 | 2.44E-03 | 2.20E-03 | 3.05E-03 | 2.08E-03 | 1.66E-05 | 0. | 3.62E-05 | 4.33E-06 |
| 21 - 22 | 2.42E-03 | 0. | 2.02E-03 | 2.54E-03 | 2.19E-03 | 3.06E-03 | 2.04E-03 | 1.39E-05 | 0. | 2.81E-05 | 3.46E-06 |
| 22 - 23 | 2.50E-03 | 0. | 2.23E-03 | 2.62E-03 | 2.18E-03 | 3.06E-03 | 1.99E-03 | 1.15E-05 | 0. | 2.19E-05 | 2.69E-06 |
| 23 - 24 | 2.59E-03 | 0. | 2.39E-03 | 2.86E-03 | 2.15E-03 | 3.11E-03 | 1.95E-03 | 9.23E-06 | 0. | 1.69E-05 | 2.08E-06 |
| 24 - 25 | 2.69E-03 | 0. | 2.59E-03 | 2.89E-03 | 2.25E-03 | 3.26E-03 | 1.90E-03 | 7.27E-06 | 0. | 1.34E-05 | 1.64E-06 |
| 25 - 30 | 2.83E-03 | 0. | 3.06E-03 | 3.34E-03 | 2.16E-03 | 3.60E-03 | 1.96E-03 | 1.54E-05 | 3.33E-06 | 3.95E-05 | 8.51E-06 |
| 30 - 35 | 2.51E-03 | 0. | 2.99E-03 | 3.28E-03 | 1.84E-03 | 4.51E-03 | 1.58E-03 | 4.76E-06 | 1.03E-06 | 9.07E-06 | 1.95E-06 |
| 35 - 40 | 2.42E-03 | 0. | 2.70E-03 | 3.08E-03 | 1.75E-03 | 3.34E-03 | 1.33E-03 | 2.34E-06 | 0. | 2.94E-06 | 0. |
| 40 - 45 | 1.99E-03 | 0. | 2.12E-03 | 2.49E-03 | 1.49E-03 | 2.76E-03 | 1.05E-03 | 1.15E-06 | 0. | 1.15E-06 | 0. |
| 45 - 50 | 1.34E-03 | 0. | 1.41E-03 | 1.74E-03 | 1.05E-03 | 1.86E-03 | 7.59E-04 | 0. | 0. | 0. | 0. |
| 50 - 70 | 2.19E-04 | 0. | 2.30E-04 | 2.72E-04 | 2.05E-04 | 2.78E-04 | 1.93E-04 | 0. | 0. | 0. | 0. |
| 70 -100 | 4.34E-06 | 0. | 4.49E-06 | 5.11E-06 | 4.47E-06 | 5.19E-06 | 4.90E-06 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | CLEAR $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 4.27E-02 | 3.30E-02 |
| MARITIME | 4.67E-03 | 7.25E-03 | 5.09E-02 | 7.90E-02 |
| TROPOSPHERIC | 1.09E-03 | 2.10E-04 | ******** | ******** |

WAVELENGTH = 10.274441 MICROMETERS
FREQUENCY = 973.289 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.44E-01 | 0. | 5.23E-01 | 3.50E-01 | 8.70E-02 | 2.10E-01 | 4.54E-02 | 3.29E-03 | 3.99E-03 | 3.58E-02 | 4.34E-02 |
| 0 - 1 | 1.24E-01 | 0. | 4.05E-01 | 2.71E-01 | 7.74E-02 | 1.68E-01 | 4.60E-02 | 2.18E-03 | 2.64E-03 | 3.58E-02 | 4.34E-02 |
| 1 - 2 | 9.26E-02 | 0. | 2.54E-01 | 1.68E-01 | 6.32E-02 | 1.15E-01 | 4.42E-02 | 2.93E-04 | 5.71E-05 | 4.67E-03 | 9.09E-04 |
| 2 - 3 | 7.02E-02 | 0. | 1.50E-01 | 1.09E-01 | 5.31E-02 | 8.38E-02 | 3.92E-02 | 1.50E-04 | 2.92E-05 | 7.90E-04 | 1.54E-04 |
| 3 - 4 | 5.47E-02 | 0. | 9.09E-02 | 7.66E-02 | 4.39E-02 | 6.43E-02 | 3.38E-02 | 1.22E-04 | 2.38E-05 | 4.32E-04 | 8.41E-05 |
| 4 - 5 | 4.37E-02 | 0. | 6.71E-02 | 5.94E-02 | 3.59E-02 | 5.09E-02 | 2.78E-02 | 9.41E-05 | 1.83E-05 | 2.25E-04 | 4.38E-05 |
| 5 - 6 | 3.56E-02 | 0. | 5.42E-02 | 4.89E-02 | 2.97E-02 | 4.09E-02 | 2.23E-02 | 6.99E-05 | 1.36E-05 | 1.42E-04 | 2.77E-05 |
| 6 - 7 | 2.90E-02 | 0. | 4.40E-02 | 4.15E-02 | 2.45E-02 | 3.22E-02 | 1.77E-02 | 4.83E-05 | 9.41E-06 | 1.17E-04 | 2.27E-05 |
| 7 - 8 | 2.36E-02 | 0. | 3.57E-02 | 3.39E-02 | 2.02E-02 | 2.59E-02 | 1.39E-02 | 3.05E-05 | 5.95E-06 | 7.80E-05 | 1.52E-05 |
| 8 - 9 | 1.90E-02 | 0. | 2.96E-02 | 2.77E-02 | 1.65E-02 | 2.07E-02 | 1.16E-02 | 5.35E-05 | 0. | 7.26E-05 | 9.73E-06 |
| 9 - 10 | 1.52E-02 | 0. | 2.40E-02 | 2.27E-02 | 1.33E-02 | 1.63E-02 | 1.08E-02 | 3.98E-05 | 0. | 5.37E-05 | 7.10E-06 |
| 10 - 11 | 1.20E-02 | 0. | 1.94E-02 | 1.82E-02 | 1.18E-02 | 1.45E-02 | 1.06E-02 | 3.39E-05 | 0. | 5.81E-05 | 7.68E-06 |
| 11 - 12 | 1.06E-02 | 0. | 1.53E-02 | 1.47E-02 | 1.15E-02 | 1.44E-02 | 1.06E-02 | 3.11E-05 | 0. | 6.68E-05 | 8.83E-06 |
| 12 - 13 | 1.05E-02 | 0. | 1.24E-02 | 1.15E-02 | 1.13E-02 | 1.44E-02 | 1.06E-02 | 2.91E-05 | 0. | 7.70E-05 | 1.02E-05 |
| 13 - 14 | 1.05E-02 | 0. | 9.01E-03 | 1.02E-02 | 1.10E-02 | 1.45E-02 | 1.06E-02 | 2.87E-05 | 0. | 8.36E-05 | 1.10E-05 |
| 14 - 15 | 1.05E-02 | 0. | 7.22E-03 | 1.06E-02 | 1.09E-02 | 1.48E-02 | 1.06E-02 | 2.91E-05 | 0. | 8.53E-05 | 1.13E-05 |
| 15 - 16 | 1.05E-02 | 0. | 5.43E-03 | 1.03E-02 | 1.07E-02 | 1.39E-02 | 1.06E-02 | 2.91E-05 | 0. | 8.31E-05 | 1.10E-05 |
| 16 - 17 | 1.05E-02 | 0. | 4.20E-03 | 1.02E-02 | 1.04E-02 | 1.44E-02 | 1.04E-02 | 2.81E-05 | 0. | 7.63E-05 | 1.01E-05 |
| 17 - 18 | 1.05E-02 | 0. | 4.49E-03 | 1.02E-02 | 1.03E-02 | 1.44E-02 | 1.02E-02 | 2.63E-05 | 0. | 6.68E-05 | 8.83E-06 |
| 18 - 19 | 1.05E-02 | 0. | 5.45E-03 | 1.04E-02 | 1.00E-02 | 1.43E-02 | 9.91E-03 | 2.38E-05 | 0. | 5.58E-05 | 7.37E-06 |
| 19 - 20 | 1.05E-02 | 0. | 6.45E-03 | 1.08E-02 | 9.85E-03 | 1.45E-02 | 9.65E-03 | 2.07E-05 | 0. | 4.47E-05 | 5.91E-06 |
| 20 - 21 | 1.07E-02 | 0. | 7.74E-03 | 1.12E-02 | 1.00E-02 | 1.43E-02 | 9.42E-03 | 1.75E-05 | 0. | 3.57E-05 | 4.72E-06 |
| 21 - 22 | 1.11E-02 | 0. | 9.13E-03 | 1.17E-02 | 9.95E-03 | 1.43E-02 | 9.21E-03 | 1.46E-05 | 0. | 2.85E-05 | 3.77E-06 |
| 22 - 23 | 1.15E-02 | 0. | 1.02E-02 | 1.21E-02 | 9.91E-03 | 1.43E-02 | 8.98E-03 | 1.21E-05 | 0. | 2.22E-05 | 2.93E-06 |
| 23 - 24 | 1.20E-02 | 0. | 1.18E-02 | 1.33E-02 | 9.76E-03 | 1.46E-02 | 8.77E-03 | 9.73E-06 | 0. | 1.72E-05 | 2.27E-06 |
| 24 - 25 | 1.24E-02 | 0. | 1.20E-02 | 1.35E-02 | 1.02E-02 | 1.54E-02 | 8.56E-03 | 7.66E-06 | 0. | 1.35E-05 | 1.79E-06 |
| 25 - 30 | 1.32E-02 | 0. | 1.44E-02 | 1.58E-02 | 9.87E-03 | 1.72E-02 | 8.86E-03 | 1.53E-05 | 3.26E-06 | 3.93E-05 | 8.35E-06 |
| 30 - 35 | 1.16E-02 | 0. | 1.41E-02 | 1.55E-02 | 8.30E-03 | 2.36E-02 | 7.03E-03 | 4.73E-06 | 1.01E-06 | 9.01E-06 | 1.92E-06 |
| 35 - 40 | 1.14E-02 | 0. | 1.29E-02 | 1.49E-02 | 8.04E-03 | 1.62E-02 | 6.02E-03 | 2.33E-06 | 0. | 2.92E-06 | 0. |
| 40 - 45 | 9.62E-03 | 0. | 1.03E-02 | 1.22E-02 | 7.08E-03 | 1.36E-02 | 4.87E-03 | 1.15E-06 | 0. | 1.15E-06 | 0. |
| 45 - 50 | 6.54E-03 | 0. | 6.92E-03 | 8.61E-03 | 5.08E-03 | 9.25E-03 | 3.60E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 1.62E-03 | 0. | 1.07E-03 | 1.27E-03 | 9.56E-04 | 1.29E-03 | 9.09E-04 | 0. | 0. | 0. | 0. |
| 70 -100 | 1.84E-05 | 0. | 1.90E-05 | 2.17E-05 | 1.93E-05 | 2.19E-05 | 2.17E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 4.37E-02 | 3.30E-02 |
| MARITIME | 4.56E-03 | 7.88E-03 | 4.96E-02 | 8.58E-02 |
| TROPOSPHERIC | 1.17E-03 | 2.27E-04 | ******** | ******** |

WAVELENGTH = 10.260378 MICROMETERS
FREQUENCY = 974.623 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.29E-01 | 0. | 4.52E-01 | 3.06E-01 | 8.02E-02 | 1.86E-01 | 4.32E-02 | 3.30E-03 | 3.99E-03 | 3.60E-02 | 4.34E-02 |
| 0 - 1 | 1.12E-01 | 0. | 3.53E-01 | 2.39E-01 | 7.20E-02 | 1.50E-01 | 4.38E-02 | 2.18E-03 | 2.64E-03 | 3.60E-02 | 4.34E-02 |
| 1 - 2 | 8.58E-02 | 0. | 2.26E-01 | 1.51E-01 | 5.97E-02 | 1.05E-01 | 4.23E-02 | 2.95E-04 | 5.75E-05 | 4.70E-03 | 9.16E-04 |
| 2 - 3 | 6.64E-02 | 0. | 1.36E-01 | 1.01E-01 | 5.07E-02 | 7.84E-02 | 3.76E-02 | 1.51E-04 | 2.94E-05 | 7.95E-04 | 1.55E-04 |
| 3 - 4 | 5.24E-02 | 0. | 8.53E-02 | 7.26E-02 | 4.23E-02 | 6.12E-02 | 3.26E-02 | 1.23E-04 | 2.40E-05 | 4.35E-04 | 8.47E-05 |
| 4 - 5 | 4.22E-02 | 0. | 6.42E-02 | 5.71E-02 | 3.47E-02 | 4.89E-02 | 2.68E-02 | 9.47E-05 | 1.85E-05 | 2.26E-04 | 4.41E-05 |
| 5 - 6 | 3.44E-02 | 0. | 5.24E-02 | 4.73E-02 | 2.87E-02 | 3.95E-02 | 2.14E-02 | 7.03E-05 | 1.37E-05 | 1.43E-04 | 2.79E-05 |
| 6 - 7 | 2.80E-02 | 0. | 4.26E-02 | 4.03E-02 | 2.36E-02 | 3.11E-02 | 1.69E-02 | 4.86E-05 | 9.43E-06 | 1.17E-04 | 2.29E-05 |
| 7 - 8 | 2.28E-02 | 0. | 3.46E-02 | 3.29E-02 | 1.94E-02 | 2.50E-02 | 1.33E-02 | 3.07E-05 | 5.99E-06 | 7.85E-05 | 1.53E-05 |
| 8 - 9 | 1.83E-02 | 0. | 2.88E-02 | 2.68E-02 | 1.57E-02 | 1.99E-02 | 1.10E-02 | 5.38E-05 | 0. | 7.37E-05 | 9.83E-06 |
| 9 - 10 | 1.45E-02 | 0. | 2.31E-02 | 2.19E-02 | 1.26E-02 | 1.56E-02 | 1.03E-02 | 4.00E-05 | 0. | 5.36E-05 | 7.16E-06 |
| 10 - 11 | 1.14E-02 | 0. | 1.86E-02 | 1.79E-02 | 1.12E-02 | 1.38E-02 | 1.02E-02 | 3.41E-05 | 0. | 5.31E-05 | 7.74E-06 |
| 11 - 12 | 1.00E-02 | 0. | 1.46E-02 | 1.40E-02 | 1.10E-02 | 1.39E-02 | 1.03E-02 | 3.13E-05 | 0. | 6.69E-05 | 8.90E-06 |
| 12 - 13 | 9.97E-03 | 0. | 1.18E-02 | 1.09E-02 | 1.08E-02 | 1.37E-02 | 1.02E-02 | 2.92E-05 | 0. | 7.71E-05 | 1.03E-05 |
| 13 - 14 | 9.97E-03 | 0. | 8.50E-03 | 9.70E-03 | 1.05E-02 | 1.39E-02 | 1.02E-02 | 2.88E-05 | 0. | 8.37E-05 | 1.11E-05 |
| 14 - 15 | 9.97E-03 | 0. | 6.78E-03 | 1.01E-02 | 1.03E-02 | 1.41E-02 | 1.03E-02 | 2.93E-05 | 0. | 8.54E-05 | 1.14E-05 |
| 15 - 16 | 9.97E-03 | 0. | 5.07E-03 | 9.76E-03 | 1.01E-02 | 1.33E-02 | 1.01E-02 | 2.92E-05 | 0. | 8.32E-05 | 1.11E-05 |
| 16 - 17 | 9.93E-03 | 0. | 3.90E-03 | 9.62E-03 | 9.89E-03 | 1.36E-02 | 9.87E-03 | 2.82E-05 | 0. | 7.64E-05 | 1.02E-05 |
| 17 - 18 | 9.95E-03 | 0. | 4.18E-03 | 9.69E-03 | 9.76E-03 | 1.37E-02 | 9.63E-03 | 2.65E-05 | 0. | 6.69E-05 | 8.91E-06 |
| 18 - 19 | 9.95E-03 | 0. | 5.09E-03 | 9.83E-03 | 9.48E-03 | 1.37E-02 | 9.40E-03 | 2.40E-05 | 0. | 5.58E-05 | 7.43E-06 |
| 19 - 20 | 9.94E-03 | 0. | 6.05E-03 | 1.03E-02 | 9.33E-03 | 1.38E-02 | 9.13E-03 | 2.08E-05 | 0. | 4.48E-05 | 5.96E-06 |
| 20 - 21 | 1.01E-02 | 0. | 7.28E-03 | 1.06E-02 | 9.48E-03 | 1.36E-02 | 8.91E-03 | 1.76E-05 | 0. | 3.57E-05 | 4.76E-06 |
| 21 - 22 | 1.05E-02 | 0. | 8.62E-03 | 1.11E-02 | 9.42E-03 | 1.37E-02 | 8.71E-03 | 1.47E-05 | 0. | 2.85E-05 | 3.80E-06 |
| 22 - 23 | 1.09E-02 | 0. | 9.61E-03 | 1.15E-02 | 9.38E-03 | 1.37E-02 | 8.48E-03 | 1.22E-05 | 0. | 2.22E-05 | 2.96E-06 |
| 23 - 24 | 1.14E-02 | 0. | 1.04E-02 | 1.27E-02 | 9.24E-03 | 1.39E-02 | 8.27E-03 | 9.78E-06 | 0. | 1.72E-05 | 2.29E-06 |
| 24 - 25 | 1.18E-02 | 0. | 1.14E-02 | 1.28E-02 | 9.69E-03 | 1.47E-02 | 8.07E-03 | 7.70E-06 | 0. | 1.35E-05 | 1.80E-06 |
| 25 - 30 | 1.26E-02 | 0. | 1.38E-02 | 1.51E-02 | 9.34E-03 | 1.64E-02 | 8.37E-03 | 1.53E-05 | 3.26E-06 | 3.92E-05 | 8.34E-06 |
| 30 - 35 | 1.11E-02 | 0. | 1.35E-02 | 1.49E-02 | 7.84E-03 | 2.27E-02 | 6.62E-03 | 4.73E-06 | 1.00E-06 | 9.01E-06 | 1.91E-06 |
| 35 - 40 | 1.09E-02 | 0. | 1.24E-02 | 1.42E-02 | 7.64E-03 | 1.56E-02 | 5.69E-03 | 2.32E-06 | 0. | 2.92E-06 | 0. |
| 40 - 45 | 9.26E-03 | 0. | 9.88E-03 | 1.18E-02 | 6.78E-03 | 1.32E-02 | 4.63E-03 | 1.14E-06 | 0. | 1.14E-06 | 0. |
| 45 - 50 | 6.32E-03 | 0. | 6.69E-03 | 8.34E-03 | 4.89E-03 | 8.98E-03 | 3.45E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 9.68E-04 | 0. | 1.01E-03 | 1.21E-03 | 9.12E-04 | 1.23E-03 | 8.70E-04 | 0. | 0. | 0. | 0. |
| 70 -100 | 1.71E-05 | 0. | 1.77E-05 | 2.01E-05 | 1.80E-05 | 2.04E-05 | 2.04E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 4.38E-02 | 3.30E-02 |
| MARITIME | 4.55E-03 | 7.94E-03 | 4.95E-02 | 8.65E-02 |
| TROPOSPHERIC | 1.17E-03 | 2.29E-04 | ******** | ******** |

WAVELENGTH = 10.246626 MICROMETERS
FREQUENCY = 975.931 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3.29E-01 | 0. | 1.32E+00 | 8.63E-01 | 1.62E-01 | 4.93E-01 | 6.02E-02 | 3.31E-03 | 3.98E-03 | 3.61E-02 | 4.34E-02 |
| 0 - 1 | 2.64E-01 | 0. | 1.00E+00 | 6.60E-01 | 1.35E-01 | 3.79E-01 | 6.07E-02 | 2.19E-03 | 2.64E-03 | 3.61E-02 | 4.34E-02 |
| 1 - 2 | 1.70E-01 | 0. | 5.95E-01 | 3.79E-01 | 9.70E-02 | 2.30E-01 | 5.54E-02 | 2.97E-04 | 5.79E-05 | 4.73E-03 | 9.22E-04 |
| 2 - 3 | 1.09E-01 | 0. | 3.19E-01 | 2.09E-01 | 7.13E-02 | 1.45E-01 | 4.50E-02 | 1.52E-04 | 2.96E-05 | 8.00E-04 | 1.56E-04 |
| 3 - 4 | 7.11E-02 | 0. | 1.55E-01 | 1.20E-01 | 5.11E-02 | 9.37E-02 | 3.56E-02 | 1.24E-04 | 2.41E-05 | 4.37E-04 | 8.53E-05 |
| 4 - 5 | 4.94E-02 | 0. | 9.22E-02 | 7.59E-02 | 3.73E-02 | 6.31E-02 | 2.70E-02 | 9.53E-05 | 1.86E-05 | 2.28E-04 | 4.44E-05 |
| 5 - 6 | 3.64E-02 | 0. | 6.44E-02 | 5.40E-02 | 2.87E-02 | 4.43E-02 | 2.05E-02 | 7.08E-05 | 1.38E-05 | 1.44E-04 | 2.81E-05 |
| 6 - 7 | 2.79E-02 | 0. | 4.63E-02 | 4.21E-02 | 2.26E-02 | 3.18E-02 | 1.58E-02 | 4.89E-05 | 9.54E-06 | 1.18E-04 | 2.30E-05 |
| 7 - 8 | 2.17E-02 | 0. | 3.48E-02 | 3.25E-02 | 1.80E-02 | 2.41E-02 | 1.22E-02 | 3.09E-05 | 6.04E-06 | 7.90E-05 | 1.54E-05 |
| 8 - 9 | 1.70E-02 | 0. | 2.77E-02 | 2.56E-02 | 1.44E-02 | 1.85E-02 | 9.98E-03 | 5.40E-05 | 0. | 7.38E-05 | 9.88E-06 |
| 9 - 10 | 1.33E-02 | 0. | 2.16E-02 | 2.05E-02 | 1.15E-02 | 1.43E-02 | 9.27E-03 | 4.02E-05 | 0. | 5.39E-05 | 7.21E-06 |
| 10 - 11 | 1.04E-02 | 0. | 1.72E-02 | 1.61E-02 | 1.01E-02 | 1.26E-02 | 9.26E-03 | 3.43E-05 | 0. | 5.82E-05 | 7.79E-06 |
| 11 - 12 | 9.06E-03 | 0. | 1.33E-02 | 1.28E-02 | 9.93E-03 | 1.25E-02 | 9.29E-03 | 3.14E-05 | 0. | 6.70E-05 | 8.97E-06 |
| 12 - 13 | 9.01E-03 | 0. | 1.07E-02 | 9.90E-03 | 9.74E-03 | 1.25E-02 | 9.24E-03 | 2.94E-05 | 0. | 7.72E-05 | 1.03E-05 |
| 13 - 14 | 9.01E-03 | 0. | 7.66E-03 | 8.76E-03 | 9.49E-03 | 1.26E-02 | 9.24E-03 | 2.89E-05 | 0. | 8.38E-05 | 1.12E-05 |
| 14 - 15 | 9.00E-03 | 0. | 6.07E-03 | 9.09E-03 | 9.34E-03 | 1.28E-02 | 9.28E-03 | 2.94E-05 | 0. | 8.55E-05 | 1.15E-05 |
| 15 - 16 | 9.00E-03 | 0. | 4.51E-03 | 8.81E-03 | 9.14E-03 | 1.21E-02 | 9.11E-03 | 2.93E-05 | 0. | 8.33E-05 | 1.12E-05 |
| 16 - 17 | 8.97E-03 | 0. | 3.45E-03 | 8.68E-03 | 8.92E-03 | 1.29E-02 | 8.90E-03 | 2.84E-05 | 0. | 7.65E-05 | 1.02E-05 |
| 17 - 18 | 8.99E-03 | 0. | 3.70E-03 | 8.75E-03 | 8.80E-03 | 1.25E-02 | 8.68E-03 | 2.66E-05 | 0. | 6.70E-05 | 8.97E-06 |
| 18 - 19 | 8.98E-03 | 0. | 4.53E-03 | 8.87E-03 | 8.56E-03 | 1.25E-02 | 8.47E-03 | 2.41E-05 | 0. | 5.59E-05 | 7.48E-06 |
| 19 - 20 | 8.98E-03 | 0. | 5.40E-03 | 9.27E-03 | 8.41E-03 | 1.26E-02 | 8.23E-03 | 2.09E-05 | 0. | 4.48E-05 | 6.00E-06 |
| 20 - 21 | 9.16E-03 | 0. | 6.53E-03 | 9.62E-03 | 8.55E-03 | 1.24E-02 | 8.03E-03 | 1.77E-05 | 0. | 3.58E-05 | 4.79E-06 |
| 21 - 22 | 9.54E-03 | 0. | 7.77E-03 | 1.01E-02 | 8.50E-03 | 1.25E-02 | 7.84E-03 | 1.48E-05 | 0. | 2.86E-05 | 3.83E-06 |
| 22 - 23 | 9.91E-03 | 0. | 8.68E-03 | 1.05E-02 | 8.47E-03 | 1.24E-02 | 7.64E-03 | 1.23E-05 | 0. | 2.22E-05 | 2.98E-06 |
| 23 - 24 | 1.03E-02 | 0. | 9.40E-03 | 1.15E-02 | 8.34E-03 | 1.27E-02 | 7.45E-03 | 9.22E-06 | 0. | 1.72E-05 | 2.30E-06 |
| 24 - 25 | 1.07E-02 | 0. | 1.03E-02 | 1.17E-02 | 8.75E-03 | 1.34E-02 | 7.26E-03 | 7.73E-06 | 0. | 1.36E-05 | 1.82E-06 |
| 25 - 30 | 1.15E-02 | 0. | 1.25E-02 | 1.38E-02 | 8.44E-03 | 1.51E-02 | 7.54E-03 | 1.53E-05 | 3.25E-06 | 3.92E-05 | 8.32E-06 |
| 30 - 35 | 1.01E-02 | 0. | 1.24E-02 | 1.37E-02 | 7.12E-03 | 2.10E-02 | 5.99E-03 | 4.73E-06 | 1.00E-06 | 9.00E-06 | 1.91E-06 |
| 35 - 40 | 1.01E-02 | 0. | 1.15E-02 | 1.32E-02 | 7.02E-03 | 1.45E-02 | 5.19E-03 | 2.32E-06 | 0. | 2.92E-06 | 0. |
| 40 - 45 | 8.64E-03 | 0. | 9.23E-03 | 1.10E-02 | 6.29E-03 | 1.24E-02 | 4.27E-03 | 1.14E-06 | 0. | 1.14E-06 | 0. |
| 45 - 50 | 5.93E-03 | 0. | 6.26E-03 | 7.85E-03 | 4.58E-03 | 8.47E-03 | 3.20E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 8.95E-04 | 0. | 9.38E-04 | 1.12E-03 | 8.45E-04 | 1.14E-03 | 8.08E-04 | 0. | 0. | 0. | 0. |
| 70 -100 | 1.54E-05 | 0. | 1.60E-05 | 1.81E-05 | 1.64E-05 | 1.83E-05 | 1.86E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 4.39E-02 | 3.30E-02 |
| MARITIME | 4.53E-03 | 8.00E-03 | 4.94E-02 | 8.71E-02 |
| TROPOSPHERIC | 1.18E-03 | 2.31E-04 | ******** | ******** |

WAVELENGTH = 10.233163 MICROMETERS
FREQUENCY = 977.215 WAVENUMBER

| ht(km) | U.S. STANDARD $\ell_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\ell_m$(km$^{-1}$) | MIDLAT SUMMER $\ell_m$(km$^{-1}$) | MIDLAT WINTER $\ell_m$(km$^{-1}$) | SUBARCTIC SUMMER $\ell_m$(km$^{-1}$) | SUBARCTIC WINTER $\ell_m$(km$^{-1}$) | AEROSOL CLEAR $\ell_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\ell_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.47E-01 | 0. | 5.52E-01 | 3.69E-01 | 8.51E-02 | 2.19E-01 | 4.07E-02 | 3.33E-03 | 3.98E-03 | 3.62E-02 | 4.34E-02 |
| 0 - 1 | 1.24E-01 | 0. | 4.26E-01 | 2.84E-01 | 7.46E-02 | 1.72E-01 | 4.13E-02 | 2.20E-03 | 2.64E-03 | 3.62E-02 | 4.34E-02 |
| 1 - 2 | 8.98E-02 | 0. | 2.64E-01 | 1.72E-01 | 5.99E-02 | 1.15E-01 | 3.91E-02 | 2.98E-04 | 5.83E-05 | 4.76E-03 | 9.29E-04 |
| 2 - 3 | 6.55E-02 | 0. | 1.51E-01 | 1.07E-01 | 4.79E-02 | 8.05E-02 | 3.40E-02 | 1.53E-04 | 2.98E-05 | 8.05E-04 | 1.57E-04 |
| 3 - 4 | 4.91E-02 | 0. | 8.68E-02 | 7.18E-02 | 3.84E-02 | 5.93E-02 | 2.86E-02 | 1.24E-04 | 2.43E-05 | 4.40E-04 | 8.59E-05 |
| 4 - 5 | 3.80E-02 | 0. | 5.12E-02 | 5.33E-02 | 3.05E-02 | 4.52E-02 | 2.30E-02 | 9.59E-05 | 1.87E-05 | 2.29E-04 | 4.47E-05 |
| 5 - 6 | 3.01E-02 | 0. | 4.80E-02 | 4.25E-02 | 2.47E-02 | 3.52E-02 | 1.80E-02 | 7.12E-05 | 1.39E-05 | 1.45E-04 | 2.83E-05 |
| 6 - 7 | 2.40E-02 | 0. | 3.78E-02 | 3.53E-02 | 2.00E-02 | 2.70E-02 | 1.40E-02 | 4.92E-05 | 9.61E-06 | 1.19E-04 | 2.32E-05 |
| 7 - 8 | 1.92E-02 | 0. | 3.00E-02 | 2.83E-02 | 1.61E-02 | 2.12E-02 | 1.08E-02 | 3.11E-05 | 6.08E-06 | 7.95E-05 | 1.55E-05 |
| 8 - 9 | 1.52E-02 | 0. | 2.46E-02 | 2.27E-02 | 1.29E-02 | 1.66E-02 | 8.88E-03 | 5.43E-05 | 0. | 7.39E-05 | 9.95E-06 |
| 9 - 10 | 1.19E-02 | 0. | 1.94E-02 | 1.83E-02 | 1.03E-02 | 1.28E-02 | 8.24E-03 | 4.04E-05 | 0. | 5.39E-05 | 7.27E-06 |
| 10 - 11 | 9.22E-03 | 0. | 1.55E-02 | 1.44E-02 | 9.02E-03 | 1.13E-02 | 8.23E-03 | 3.44E-05 | 0. | 5.83E-05 | 7.85E-06 |
| 11 - 12 | 8.05E-03 | 0. | 1.20E-02 | 1.14E-02 | 8.84E-03 | 1.12E-02 | 8.25E-03 | 3.16E-05 | 0. | 6.71E-05 | 9.04E-06 |
| 12 - 13 | 8.01E-03 | 0. | 9.57E-03 | 8.82E-03 | 8.67E-03 | 1.12E-02 | 8.21E-03 | 2.95E-05 | 0. | 7.73E-05 | 1.04E-05 |
| 13 - 14 | 8.01E-03 | 0. | 6.79E-03 | 7.78E-03 | 8.44E-03 | 1.13E-02 | 8.21E-03 | 2.91E-05 | 0. | 8.39E-05 | 1.13E-05 |
| 14 - 15 | 8.01E-03 | 0. | 5.34E-03 | 8.07E-03 | 8.31E-03 | 1.15E-02 | 8.25E-03 | 2.96E-05 | 0. | 8.56E-05 | 1.15E-05 |
| 15 - 16 | 8.00E-03 | 0. | 3.94E-03 | 7.83E-03 | 8.12E-03 | 1.08E-02 | 8.09E-03 | 2.95E-05 | 0. | 8.34E-05 | 1.12E-05 |
| 16 - 17 | 7.98E-03 | 0. | 3.00E-03 | 7.71E-03 | 7.93E-03 | 1.12E-02 | 7.91E-03 | 2.85E-05 | 0. | 7.66E-05 | 1.03E-05 |
| 17 - 18 | 7.99E-03 | 0. | 3.22E-03 | 7.78E-03 | 7.82E-03 | 1.12E-02 | 7.71E-03 | 2.67E-05 | 0. | 6.71E-05 | 9.04E-06 |
| 18 - 19 | 7.99E-03 | 0. | 3.96E-03 | 7.89E-03 | 7.60E-03 | 1.12E-02 | 7.52E-03 | 2.42E-05 | 0. | 5.60E-05 | 7.54E-06 |
| 19 - 20 | 7.98E-03 | 0. | 4.74E-03 | 8.25E-03 | 7.47E-03 | 1.13E-02 | 7.30E-03 | 2.10E-05 | 0. | 4.49E-05 | 6.05E-06 |
| 20 - 21 | 8.15E-03 | 0. | 5.76E-03 | 8.57E-03 | 7.59E-03 | 1.11E-02 | 7.12E-03 | 1.77E-05 | 0. | 3.58E-05 | 4.83E-06 |
| 21 - 22 | 8.50E-03 | 0. | 6.88E-03 | 8.99E-03 | 7.55E-03 | 1.12E-02 | 6.95E-03 | 1.48E-05 | 0. | 2.86E-05 | 3.85E-06 |
| 22 - 23 | 8.94E-03 | 0. | 7.72E-03 | 9.35E-03 | 7.52E-03 | 1.12E-02 | 6.76E-03 | 1.23E-05 | 0. | 2.23E-05 | 3.00E-06 |
| 23 - 24 | 9.21E-03 | 0. | 8.38E-03 | 1.03E-02 | 7.40E-03 | 1.14E-02 | 6.59E-03 | 9.87E-06 | 0. | 1.72E-05 | 2.32E-06 |
| 24 - 25 | 9.59E-03 | 0. | 9.20E-03 | 1.05E-02 | 7.77E-03 | 1.20E-02 | 6.42E-03 | 7.77E-06 | 0. | 1.36E-05 | 1.83E-06 |
| 25 - 30 | 1.03E-02 | 0. | 1.13E-02 | 1.25E-02 | 7.51E-03 | 1.36E-02 | 6.69E-03 | 1.53E-05 | 3.25E-06 | 3.92E-05 | 8.31E-06 |
| 30 - 35 | 9.08E-03 | 0. | 1.12E-02 | 1.24E-02 | 6.33E-03 | 1.91E-02 | 5.30E-03 | 4.72E-06 | 1.00E-06 | 8.99E-06 | 1.91E-06 |
| 35 - 40 | 9.15E-03 | 0. | 1.04E-02 | 1.20E-02 | 6.29E-03 | 1.32E-02 | 4.62E-03 | 2.32E-06 | 0. | 2.91E-06 | 0. |
| 40 - 45 | 7.88E-03 | 0. | 8.41E-03 | 1.01E-02 | 5.70E-03 | 1.14E-02 | 3.83E-03 | 1.14E-06 | 0. | 1.14E-06 | 0. |
| 45 - 50 | 5.43E-03 | 0. | 5.75E-03 | 7.22E-03 | 4.18E-03 | 7.80E-03 | 2.90E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 8.05E-04 | 0. | 8.43E-04 | 1.01E-03 | 7.62E-04 | 1.03E-03 | 7.31E-04 | 0. | 0. | 0. | 0. |
| 70 -100 | 1.35E-05 | 0. | 1.40E-05 | 1.59E-05 | 1.44E-05 | 1.60E-05 | 1.65E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\ell_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\ell_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 4.40E-02 | 3.30E-02 |
| MARITIME | 4.52E-03 | 8.05E-03 | 4.93E-02 | 8.77E-02 |
| TROPOSPHERIC | 1.19E-03 | 2.32E-04 | ******** | ******** |

WAVELENGTH = 9.552430 MICROMETERS
FREQUENCY = 1046.854 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.42E-01 | 0. | 4.09E-01 | 2.89E-01 | 9.75E-02 | 1.87E-01 | 5.88E-02 | 4.26E-03 | 3.84E-03 | 4.66E-02 | 4.19E-02 |
| 0 - 1 | 1.27E-01 | 0. | 3.28E-01 | 2.33E-01 | 8.96E-02 | 1.57E-01 | 5.96E-02 | 2.83E-03 | 2.54E-03 | 4.66E-02 | 4.19E-02 |
| 1 - 2 | 1.03E-01 | 0. | 2.22E-01 | 1.60E-01 | 7.74E-02 | 1.20E-01 | 5.81E-02 | 4.48E-04 | 8.25E-05 | 7.14E-03 | 1.31E-03 |
| 2 - 3 | 8.47E-02 | 0. | 1.47E-01 | 1.18E-01 | 6.84E-02 | 9.59E-02 | 5.35E-02 | 2.29E-04 | 4.22E-05 | 1.21E-03 | 2.22E-04 |
| 3 - 4 | 7.02E-02 | 0. | 1.03E-01 | 9.30E-02 | 5.99E-02 | 8.05E-02 | 4.84E-02 | 1.87E-04 | 3.44E-05 | 6.60E-04 | 1.22E-04 |
| 4 - 5 | 5.92E-02 | 0. | 8.22E-02 | 7.85E-02 | 5.26E-02 | 6.90E-02 | 4.24E-02 | 1.44E-04 | 2.65E-05 | 3.44E-04 | 6.33E-05 |
| 5 - 6 | 5.06E-02 | 0. | 6.97E-02 | 6.88E-02 | 4.73E-02 | 6.03E-02 | 3.66E-02 | 1.07E-04 | 1.97E-05 | 2.18E-04 | 4.01E-05 |
| 6 - 7 | 4.36E-02 | 0. | 5.89E-02 | 6.19E-02 | 4.32E-02 | 5.19E-02 | 3.35E-02 | 7.39E-05 | 1.36E-05 | 1.78E-04 | 3.28E-05 |
| 7 - 8 | 3.81E-02 | 0. | 4.96E-02 | 5.43E-02 | 4.05E-02 | 4.56E-02 | 3.31E-02 | 4.67E-05 | 8.60E-06 | 1.19E-04 | 2.20E-05 |
| 8 - 9 | 3.45E-02 | 0. | 4.27E-02 | 4.80E-02 | 3.97E-02 | 4.24E-02 | 3.78E-02 | 1.12E-04 | 0. | 7.24E-05 | 1.29E-05 |
| 9 - 10 | 3.31E-02 | 0. | 3.58E-02 | 4.29E-02 | 4.16E-02 | 4.15E-02 | 4.91E-02 | 8.36E-05 | 0. | 5.29E-05 | 9.34E-06 |
| 10 - 11 | 3.37E-02 | 0. | 3.04E-02 | 3.90E-02 | 4.59E-02 | 4.38E-02 | 5.97E-02 | 7.12E-05 | 0. | 5.71E-05 | 1.01E-05 |
| 11 - 12 | 3.64E-02 | 0. | 2.55E-02 | 3.65E-02 | 5.08E-02 | 4.80E-02 | 6.97E-02 | 6.54E-05 | 0. | 6.58E-05 | 1.16E-05 |
| 12 - 13 | 3.71E-02 | 0. | 2.21E-02 | 3.46E-02 | 5.34E-02 | 5.07E-02 | 7.43E-02 | 6.10E-05 | 0. | 7.58E-05 | 1.34E-05 |
| 13 - 14 | 3.64E-02 | 0. | 1.76E-02 | 3.54E-02 | 5.27E-02 | 5.19E-02 | 7.10E-02 | 6.02E-05 | 0. | 8.22E-05 | 1.45E-05 |
| 14 - 15 | 3.60E-02 | 0. | 1.51E-02 | 3.58E-02 | 5.03E-02 | 5.17E-02 | 6.88E-02 | 6.12E-05 | 0. | 8.40E-05 | 1.48E-05 |
| 15 - 16 | 3.57E-02 | 0. | 1.25E-02 | 3.42E-02 | 4.75E-02 | 4.97E-02 | 6.77E-02 | 6.10E-05 | 0. | 8.18E-05 | 1.44E-05 |
| 16 - 17 | 3.58E-02 | 0. | 1.14E-02 | 3.37E-02 | 4.50E-02 | 4.94E-02 | 6.23E-02 | 5.90E-05 | 0. | 7.51E-05 | 1.33E-05 |
| 17 - 18 | 3.58E-02 | 0. | 1.29E-02 | 3.39E-02 | 4.25E-02 | 4.73E-02 | 5.60E-02 | 5.53E-05 | 0. | 6.58E-05 | 1.16E-05 |
| 18 - 19 | 3.51E-02 | 0. | 1.54E-02 | 3.39E-02 | 3.95E-02 | 4.47E-02 | 4.93E-02 | 5.00E-05 | 0. | 5.49E-05 | 9.69E-06 |
| 19 - 20 | 3.37E-02 | 0. | 1.84E-02 | 3.33E-02 | 3.67E-02 | 4.07E-02 | 4.23E-02 | 4.34E-05 | 0. | 4.40E-05 | 7.77E-06 |
| 20 - 21 | 3.17E-02 | 0. | 2.09E-02 | 3.20E-02 | 3.35E-02 | 3.61E-02 | 3.58E-02 | 3.67E-05 | 0. | 3.51E-05 | 6.20E-06 |
| 21 - 22 | 2.98E-02 | 0. | 2.27E-02 | 3.05E-02 | 3.00E-02 | 3.22E-02 | 3.05E-02 | 3.07E-05 | 0. | 2.80E-05 | 4.95E-06 |
| 22 - 23 | 2.79E-02 | 0. | 2.36E-02 | 2.83E-02 | 2.67E-02 | 2.91E-02 | 2.62E-02 | 2.55E-05 | 0. | 2.18E-05 | 3.86E-06 |
| 23 - 24 | 2.60E-02 | 0. | 2.38E-02 | 2.71E-02 | 2.34E-02 | 2.72E-02 | 2.22E-02 | 2.04E-05 | 0. | 1.69E-05 | 2.98E-06 |
| 24 - 25 | 2.45E-02 | 0. | 2.38E-02 | 2.52E-02 | 2.18E-02 | 2.62E-02 | 1.90E-02 | 1.61E-05 | 0. | 1.33E-05 | 2.35E-06 |
| 25 - 30 | 2.09E-02 | 0. | 2.27E-02 | 2.39E-02 | 1.67E-02 | 2.46E-02 | 1.47E-02 | 1.30E-05 | 2.50E-06 | 3.32E-05 | 6.40E-06 |
| 30 - 35 | 1.49E-02 | 0. | 1.77E-02 | 1.93E-02 | 1.09E-02 | 2.95E-02 | 9.21E-03 | 4.00E-06 | 0. | 7.62E-06 | 1.47E-06 |
| 35 - 40 | 1.33E-02 | 0. | 1.48E-02 | 1.70E-02 | 9.44E-03 | 1.85E-02 | 7.15E-03 | 1.97E-06 | 0. | 2.47E-06 | 0. |
| 40 - 45 | 1.07E-02 | 0. | 1.14E-02 | 1.35E-02 | 7.92E-03, | 1.50E-02 | 5.51E-03 | 0. | 0. | 0. | 0. |
| 45 - 50 | 7.15E-03 | 0. | 7.56E-03 | 9.36E-03 | 5.57E-03 | 1.00E-02 | 3.98E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 1.13E-03 | 0. | 1.18E-03 | 1.41E-03 | 1.06E-03 | 1.44E-03 | 1.00E-03 | 0. | 0. | 0. | 0. |
| 70 -100 | 2.11E-05 | 0. | 2.19E-05 | 2.49E-05 | 2.20E-05 | 2.53E-05 | 2.45E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.06E-02 | 3.25E-02 |
| MARITIME | 4.42E-03 | 1.10E-02 | 4.82E-02 | 1.19E-01 |
| TROPOSPHERIC | 1.79E-03 | 3.29E-04 | ******** | ******** |

WAVELENGTH = 9.535978 MICROMETERS
FREQUENCY = 1048.661 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.52E-01 | 0. | 4.30E-01 | 3.06E-01 | 1.07E-01 | 1.09E-01 | 6.50E-02 | 4.33E-03 | 3.83E-03 | 4.71E-02 | 4.17E-02 |
| 0 - 1 | 1.37E-01 | 0. | 3.45E-01 | 2.48E-01 | 9.84E-02 | 1.68E-01 | 6.59E-02 | 2.86E-03 | 2.54E-03 | 4.71E-02 | 4.17E-02 |
| 1 - 2 | 1.12E-01 | 0. | 2.35E-01 | 1.72E-01 | 8.53E-02 | 1.29E-01 | 6.45E-02 | 4.55E-04 | 8.31E-05 | 7.25E-03 | 1.32E-03 |
| 2 - 3 | 9.31E-02 | 0. | 1.57E-01 | 1.28E-01 | 7.60E-02 | 1.05E-01 | 6.00E-02 | 2.33E-04 | 4.25E-05 | 1.23E-03 | 2.24E-04 |
| 3 - 4 | 7.79E-02 | 0. | 1.12E-01 | 1.03E-01 | 6.74E-02 | 8.96E-02 | 5.52E-02 | 1.90E-04 | 3.47E-05 | 6.71E-04 | 1.23E-04 |
| 4 - 5 | 6.67E-02 | 0. | 9.03E-02 | 8.83E-02 | 6.07E-02 | 7.84E-02 | 4.96E-02 | 1.46E-04 | 2.67E-05 | 3.49E-04 | 6.37E-05 |
| 5 - 6 | 5.82E-02 | 0. | 7.76E-02 | 7.91E-02 | 5.66E-02 | 7.05E-02 | 4.42E-02 | 1.09E-04 | 1.98E-05 | 2.21E-04 | 4.04E-05 |
| 6 - 7 | 5.16E-02 | 0. | 6.66E-02 | 7.32E-02 | 5.41E-02 | 6.32E-02 | 4.30E-02 | 7.50E-05 | 1.37E-05 | 1.81E-04 | 3.31E-05 |
| 7 - 8 | 4.70E-02 | 0. | 5.72E-02 | 6.68E-02 | 5.40E-02 | 5.81E-02 | 4.62E-02 | 4.75E-05 | 8.67E-06 | 1.21E-04 | 2.21E-05 |
| 8 - 9 | 4.55E-02 | 0. | 5.05E-02 | 6.21E-02 | 5.75E-02 | 5.83E-02 | 5.89E-02 | 1.14E-04 | 0. | 7.23E-05 | 1.28E-05 |
| 9 - 10 | 4.81E-02 | 0. | 4.39E-02 | 5.88E-02 | 6.70E-02 | 6.30E-02 | 8.60E-02 | 8.49E-05 | 0. | 5.24E-05 | 9.38E-06 |
| 10 - 11 | 5.53E-02 | 0. | 3.92E-02 | 5.83E-02 | 8.22E-02 | 7.36E-02 | 1.16E-01 | 7.24E-05 | 0. | 5.70E-05 | 1.01E-05 |
| 11 - 12 | 6.72E-02 | 0. | 3.51E-02 | 6.03E-02 | 1.01E-01 | 8.85E-02 | 1.51E-01 | 6.64E-05 | 0. | 6.56E-05 | 1.17E-05 |
| 12 - 13 | 7.45E-02 | 0. | 3.27E-02 | 6.44E-02 | 1.17E-01 | 1.02E-01 | 1.77E-01 | 6.20E-05 | 0. | 7.56E-05 | 1.34E-05 |
| 13 - 14 | 7.91E-02 | 0. | 2.89E-02 | 7.30E-02 | 1.26E-01 | 1.14E-01 | 1.85E-01 | 6.11E-05 | 0. | 8.21E-05 | 1.46E-05 |
| 14 - 15 | 8.43E-02 | 0. | 2.70E-02 | 8.04E-02 | 1.29E-01 | 1.22E-01 | 1.93E-01 | 6.21E-05 | 0. | 8.38E-05 | 1.49E-05 |
| 15 - 16 | 8.96E-02 | 0. | 2.49E-02 | 8.26E-02 | 1.30E-01 | 1.27E-01 | 2.05E-01 | 6.20E-05 | 0. | 8.16E-05 | 1.45E-05 |
| 16 - 17 | 9.60E-02 | 0. | 2.63E-02 | 8.69E-02 | 1.31E-01 | 1.32E-01 | 2.01E-01 | 5.99E-05 | 0. | 7.49E-05 | 1.33E-05 |
| 17 - 18 | 1.02E-01 | 0. | 3.23E-02 | 9.27E-02 | 1.29E-01 | 1.34E-01 | 1.86E-01 | 5.61E-05 | 0. | 6.56E-05 | 1.17E-05 |
| 18 - 19 | 1.03E-01 | 0. | 4.09E-02 | 9.73E-02 | 1.24E-01 | 1.28E-01 | 1.67E-01 | 5.08E-05 | 0. | 5.48E-05 | 9.73E-06 |
| 19 - 20 | 1.01E-01 | 0. | 5.12E-02 | 9.72E-02 | 1.17E-01 | 1.15E-01 | 1.44E-01 | 4.41E-05 | 0. | 4.39E-05 | 7.81E-06 |
| 20 - 21 | 9.50E-02 | 0. | 5.87E-02 | 9.31E-02 | 1.06E-01 | 9.93E-02 | 1.19E-01 | 3.73E-05 | 0. | 3.51E-05 | 6.23E-06 |
| 21 - 22 | 8.66E-02 | 0. | 6.26E-02 | 8.65E-02 | 9.24E-02 | 8.37E-02 | 9.82E-02 | 3.12E-05 | 0. | 2.80E-05 | 4.98E-06 |
| 22 - 23 | 7.78E-02 | 0. | 6.35E-02 | 7.63E-02 | 7.91E-02 | 7.11E-02 | 8.09E-02 | 2.59E-05 | 0. | 2.18E-05 | 3.87E-06 |
| 23 - 24 | 6.80E-02 | 0. | 6.20E-02 | 6.70E-02 | 6.55E-02 | 6.19E-02 | 6.41E-02 | 2.07E-05 | 0. | 1.69E-05 | 3.00E-06 |
| 24 - 25 | 5.91E-02 | 0. | 5.79E-02 | 5.80E-02 | 5.60E-02 | 5.46E-02 | 5.06E-02 | 1.63E-05 | 0. | 1.33E-05 | 2.36E-06 |
| 25 - 30 | 3.94E-02 | 0. | 4.28E-02 | 4.25E-02 | 3.44E-02 | 3.94E-02 | 2.93E-02 | 1.29E-05 | 2.48E-06 | 3.29E-05 | 6.34E-06 |
| 30 - 35 | 2.05E-02 | 0. | 2.36E-02 | 2.51E-02 | 1.57E-02 | 3.51E-02 | 1.32E-02 | 3.97E-06 | 0. | 7.56E-06 | 1.46E-06 |
| 35 - 40 | 1.53E-02 | 0. | 1.67E-02 | 1.91E-02 | 1.10E-02 | 2.06E-02 | 8.52E-03 | 1.95E-06 | 0. | 2.45E-06 | 0. |
| 40 - 45 | 1.15E-02 | 0. | 1.23E-02 | 1.45E-02 | 8.62E-03 | 1.61E-02 | 6.07E-03 | 0. | 0. | 0. | 0. |
| 45 - 50 | 7.60E-03 | 0. | 8.04E-03 | 9.91E-03 | 5.94E-03 | 1.06E-02 | 4.27E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 1.22E-03 | 0. | 1.28E-03 | 1.51E-03 | 1.14E-03 | 1.54E-03 | 1.07E-03 | 0. | 0. | 0. | 0. |
| 70 -100 | 2.33E-05 | 0. | 2.42E-05 | 2.75E-05 | 2.42E-05 | 2.79E-05 | 2.67E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.09E-02 | 3.24E-02 |
| MARITIME | 4.43E-03 | 1.10E-02 | 4.93E-02 | 1.20E-01 |
| TROPOSPHERIC | 1.81E-03 | 2.31E-04 | ******** | ******** |

WAVELENGTH = 9.519811 MICROMETERS
FREQUENCY = 1050.441 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.64E-01 | 0. | 4.52E-01 | 3.23E-01 | 1.19E-01 | 2.11E-01 | 7.35E-02 | 4.37E-03 | 3.82E-03 | 4.76E-02 | 4.16E-02 |
| 0 - 1 | 1.48E-01 | 0. | 3.63E-01 | 2.63E-01 | 1.09E-01 | 1.50E-01 | 7.43E-02 | 2.89E-03 | 2.53E-03 | 4.76E-02 | 4.16E-02 |
| 1 - 2 | 1.23E-01 | 0. | 2.49E-01 | 1.84E-01 | 9.50E-02 | 1.40E-01 | 7.27E-02 | 4.62E-04 | 8.37E-05 | 7.36E-03 | 1.33E-03 |
| 2 - 3 | 1.02E-01 | 0. | 1.68E-01 | 1.39E-01 | 8.49E-02 | 1.15E-01 | 6.79E-02 | 2.36E-04 | 4.28E-05 | 1.25E-03 | 2.26E-04 |
| 3 - 4 | 8.61E-02 | 0. | 1.20E-01 | 1.13E-01 | 7.58E-02 | 9.93E-02 | 6.29E-02 | 1.93E-04 | 3.49E-05 | 6.81E-04 | 1.23E-04 |
| 4 - 5 | 7.41E-02 | 0. | 9.77E-02 | 9.78E-02 | 6.91E-02 | 8.76E-02 | 5.70E-02 | 1.48E-04 | 2.69E-05 | 3.54E-04 | 6.42E-05 |
| 5 - 6 | 6.49E-02 | 0. | 8.41E-02 | 8.80E-02 | 6.50E-02 | 7.95E-02 | 5.12E-02 | 1.10E-04 | 2.00E-05 | 2.25E-04 | 4.07E-05 |
| 6 - 7 | 5.77E-02 | 0. | 7.23E-02 | 8.15E-02 | 6.24E-02 | 7.17E-02 | 5.03E-02 | 7.62E-05 | 1.38E-05 | 1.84E-04 | 3.33E-05 |
| 7 - 8 | 5.24E-02 | 0. | 6.25E-02 | 7.42E-02 | 6.19E-02 | 6.55E-02 | 5.39E-02 | 4.82E-05 | 8.73E-06 | 1.23E-04 | 2.23E-05 |
| 8 - 9 | 5.04E-02 | 0. | 5.43E-02 | 6.83E-02 | 6.47E-02 | 6.50E-02 | 6.68E-02 | 1.16E-04 | 0. | 7.21E-05 | 1.29E-05 |
| 9 - 10 | 5.21E-02 | 0. | 4.68E-02 | 6.33E-02 | 7.25E-02 | 6.84E-02 | 9.19E-02 | 8.62E-05 | 0. | 5.27E-05 | 9.43E-06 |
| 10 - 11 | 5.72E-02 | 0. | 4.10E-02 | 6.06E-02 | 8.34E-02 | 7.56E-02 | 1.14E-01 | 7.35E-05 | 0. | 5.69E-05 | 1.02E-05 |
| 11 - 12 | 6.47E-02 | 0. | 3.57E-02 | 5.96E-02 | 9.39E-02 | 8.42E-02 | 1.35E-01 | 6.75E-05 | 0. | 6.55E-05 | 1.17E-05 |
| 12 - 13 | 6.60E-02 | 0. | 3.19E-02 | 5.95E-02 | 9.95E-02 | 8.97E-02 | 1.44E-01 | 6.30E-05 | 0. | 7.54E-05 | 1.35E-05 |
| 13 - 14 | 6.45E-02 | 0. | 2.87E-02 | 6.28E-02 | 9.82E-02 | 9.20E-02 | 1.37E-01 | 6.21E-05 | 0. | 8.19E-05 | 1.47E-05 |
| 14 - 15 | 6.35E-02 | 0. | 2.36E-02 | 6.31E-02 | 9.32E-02 | 9.11E-02 | 1.32E-01 | 6.31E-05 | 0. | 8.36E-05 | 1.50E-05 |
| 15 - 16 | 6.28E-02 | 0. | 2.02E-02 | 6.01E-02 | 8.76E-02 | 8.78E-02 | 1.30E-01 | 6.29E-05 | 0. | 8.14E-05 | 1.46E-05 |
| 16 - 17 | 6.30E-02 | 0. | 1.95E-02 | 5.90E-02 | 8.26E-02 | 8.64E-02 | 1.20E-01 | 6.08E-05 | 0. | 7.48E-05 | 1.34E-05 |
| 17 - 18 | 6.31E-02 | 0. | 2.22E-02 | 5.93E-02 | 7.75E-02 | 8.35E-02 | 1.06E-01 | 5.70E-05 | 0. | 6.55E-05 | 1.17E-05 |
| 18 - 19 | 6.14E-02 | 0. | 2.64E-02 | 5.93E-02 | 7.14E-02 | 7.66E-02 | 9.21E-02 | 5.16E-05 | 0. | 5.46E-05 | 9.74E-06 |
| 19 - 20 | 5.86E-02 | 0. | 3.14E-02 | 5.74E-02 | 6.57E-02 | 6.80E-02 | 7.78E-02 | 4.48E-05 | 0. | 4.38E-05 | 7.84E-06 |
| 20 - 21 | 5.42E-02 | 0. | 3.50E-02 | 5.41E-02 | 5.87E-02 | 5.87E-02 | 6.44E-02 | 3.79E-05 | 0. | 3.50E-05 | 6.26E-06 |
| 21 - 22 | 4.95E-02 | 0. | 3.71E-02 | 5.02E-02 | 5.14E-02 | 5.05E-02 | 5.34E-02 | 3.17E-05 | 0. | 2.79E-05 | 5.00E-06 |
| 22 - 23 | 4.51E-02 | 0. | 3.77E-02 | 4.50E-02 | 4.46E-02 | 4.40E-02 | 4.46E-02 | 2.63E-05 | 0. | 2.17E-05 | 3.89E-06 |
| 23 - 24 | 4.02E-02 | 0. | 3.72E-02 | 4.12E-02 | 3.79E-02 | 3.97E-02 | 3.65E-02 | 2.11E-05 | 0. | 1.68E-05 | 3.01E-06 |
| 24 - 25 | 3.47E-02 | 0. | 3.58E-02 | 3.70E-02 | 3.38E-02 | 3.64E-02 | 3.00E-02 | 1.66E-05 | 0. | 1.33E-05 | 2.37E-06 |
| 25 - 30 | 2.83E-02 | 0. | 3.06E-02 | 3.15E-02 | 2.36E-02 | 3.11E-02 | 2.06E-02 | 1.28E-05 | 2.45E-06 | 3.27E-05 | 6.28E-06 |
| 30 - 35 | 1.80E-02 | 0. | 2.11E-02 | 2.28E-02 | 1.35E-02 | 3.39E-02 | 1.15E-02 | 3.94E-06 | 0. | 7.50E-06 | 1.44E-06 |
| 35 - 40 | 1.51E-02 | 0. | 1.67E-02 | 1.91E-02 | 1.09E-02 | 2.07E-02 | 8.39E-03 | 1.93E-06 | 0. | 2.43E-06 | 0. |
| 40 - 45 | 1.19E-02 | 0. | 1.26E-02 | 1.48E-02 | 8.85E-03 | 1.64E-02 | 6.25E-03 | 0. | 0. | 0. | 0. |
| 45 - 50 | 7.80E-03 | 0. | 8.25E-03 | 1.02E-02 | 6.12E-03 | 1.09E-02 | 4.42E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 1.27E-03 | 0. | 1.33E-03 | 1.58E-03 | 1.18E-03 | 1.61E-03 | 1.11E-03 | 0. | 0. | 0. | 0. |
| 70 -100 | 2.49E-05 | 0. | 2.58E-05 | 2.94E-05 | 2.57E-05 | 2.99E-05 | 2.82E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.12E-02 | 3.23E-02 |
| MARITIME | 4.44E-03 | 1.11E-02 | 4.83E-02 | 1.21E-01 |
| TROPOSPHERIC | 1.84E-03 | 3.32E-04 | ******** | ******** |

WAVELENGTH = 9.293784 MICROMETERS
FREQUENCY = 1075.988 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.62E-01 | 0. | 4.73E-01 | 3.32E-01 | 1.04E-01 | 2.14E-01 | 6.14E-02 | 5.54E-03 | 3.72E-03 | 6.03E-02 | 4.05E-02 |
| 0 - 1 | 1.43E-01 | 0. | 3.76E-01 | 2.66E-01 | 9.53E-02 | 1.78E-01 | 6.23E-02 | 3.66E-03 | 2.46E-03 | 6.03E-02 | 4.05E-02 |
| 1 - 2 | 1.12E-01 | 0. | 2.51E-01 | 1.79E-01 | 8.14E-02 | 1.31E-01 | 6.05E-02 | 7.22E-04 | 1.01E-04 | 1.15E-02 | 1.60E-03 |
| 2 - 3 | 8.99E-02 | 0. | 1.64E-01 | 1.28E-01 | 7.09E-02 | 1.02E-01 | 5.46E-02 | 3.69E-04 | 5.14E-05 | 1.95E-03 | 2.71E-04 |
| 3 - 4 | 7.32E-02 | 0. | 1.12E-01 | 9.73E-02 | 6.06E-02 | 8.31E-02 | 4.80E-02 | 3.01E-04 | 4.19E-05 | 1.06E-03 | 1.48E-04 |
| 4 - 5 | 6.05E-02 | 0. | 8.79E-02 | 7.93E-02 | 5.10E-02 | 6.86E-02 | 4.05E-02 | 2.32E-04 | 3.23E-05 | 5.53E-04 | 7.71E-05 |
| 5 - 6 | 5.05E-02 | 0. | 7.35E-02 | 6.73E-02 | 4.30E-02 | 5.71E-02 | 3.31E-02 | 1.72E-04 | 2.40E-05 | 3.51E-04 | 4.89E-05 |
| 6 - 7 | 4.21E-02 | 0. | 6.12E-02 | 5.84E-02 | 3.62E-02 | 4.62E-02 | 2.69E-02 | 1.19E-04 | 1.66E-05 | 2.87E-04 | 4.00E-05 |
| 7 - 8 | 3.49E-02 | 0. | 5.09E-02 | 4.86E-02 | 3.03E-02 | 3.80E-02 | 2.16E-02 | 7.52E-05 | 1.05E-05 | 1.92E-04 | 2.68E-05 |
| 8 - 9 | 2.87E-02 | 0. | 4.32E-02 | 4.04E-02 | 2.52E-02 | 3.10E-02 | 1.82E-02 | 1.08E-04 | 0. | 6.83E-05 | 1.39E-05 |
| 9 - 10 | 2.34E-02 | 0. | 3.54E-02 | 3.37E-02 | 2.08E-02 | 2.49E-02 | 1.71E-02 | 8.03E-05 | 0. | 4.99E-05 | 1.02E-05 |
| 10 - 11 | 1.88E-02 | 0. | 2.92E-02 | 2.75E-02 | 1.85E-02 | 2.24E-02 | 1.71E-02 | 6.84E-05 | 0. | 5.39E-05 | 1.10E-05 |
| 11 - 12 | 1.68E-02 | 0. | 2.34E-02 | 2.26E-02 | 1.82E-02 | 2.23E-02 | 1.72E-02 | 6.28E-05 | 0. | 6.20E-05 | 1.26E-05 |
| 12 - 13 | 1.67E-02 | 0. | 1.95E-02 | 1.81E-02 | 1.79E-02 | 2.22E-02 | 1.71E-02 | 5.86E-05 | 0. | 7.15E-05 | 1.46E-05 |
| 13 - 14 | 1.67E-02 | 0. | 1.44E-02 | 1.63E-02 | 1.75E-02 | 2.24E-02 | 1.71E-02 | 5.78E-05 | 0. | 7.76E-05 | 1.58E-05 |
| 14 - 15 | 1.67E-02 | 0. | 1.18E-02 | 1.69E-02 | 1.73E-02 | 2.29E-02 | 1.72E-02 | 5.88E-05 | 0. | 7.92E-05 | 1.61E-05 |
| 15 - 16 | 1.67E-02 | 0. | 9.98E-03 | 1.64E-02 | 1.69E-02 | 2.15E-02 | 1.69E-02 | 5.86E-05 | 0. | 7.71E-05 | 1.57E-05 |
| 16 - 17 | 1.66E-02 | 0. | 7.14E-03 | 1.61E-02 | 1.65E-02 | 2.23E-02 | 1.66E-02 | 5.67E-05 | 0. | 7.08E-05 | 1.44E-05 |
| 17 - 18 | 1.67E-02 | 0. | 7.61E-03 | 1.63E-02 | 1.64E-02 | 2.22E-02 | 1.62E-02 | 5.31E-05 | 0. | 6.20E-05 | 1.26E-05 |
| 18 - 19 | 1.66E-02 | 0. | 9.10E-03 | 1.64E-02 | 1.59E-02 | 2.22E-02 | 1.58E-02 | 4.81E-05 | 0. | 5.17E-05 | 1.05E-05 |
| 19 - 20 | 1.66E-02 | 0. | 1.06E-02 | 1.71E-02 | 1.57E-02 | 2.24E-02 | 1.54E-02 | 4.17E-05 | 0. | 4.15E-05 | 8.46E-06 |
| 20 - 21 | 1.69E-02 | 0. | 1.26E-02 | 1.76E-02 | 1.60E-02 | 2.23E-02 | 1.51E-02 | 3.53E-05 | 0. | 3.31E-05 | 6.75E-06 |
| 21 - 22 | 1.75E-02 | 0. | 1.46E-02 | 1.84E-02 | 1.58E-02 | 2.22E-02 | 1.48E-02 | 2.95E-05 | 0. | 2.65E-05 | 5.39E-06 |
| 22 - 23 | 1.81E-02 | 0. | 1.61E-02 | 1.90E-02 | 1.58E-02 | 2.21E-02 | 1.44E-02 | 2.45E-05 | 0. | 2.06E-05 | 4.20E-06 |
| 23 - 24 | 1.88E-02 | 0. | 1.73E-02 | 2.07E-02 | 1.55E-02 | 2.25E-02 | 1.41E-02 | 1.96E-05 | 0. | 1.59E-05 | 3.25E-06 |
| 24 - 25 | 1.94E-02 | 0. | 1.88E-02 | 2.09E-02 | 1.63E-02 | 2.38E-02 | 1.38E-02 | 1.54E-05 | 0. | 1.26E-05 | 2.56E-06 |
| 25 - 30 | 2.05E-02 | 0. | 2.21E-02 | 2.41E-02 | 1.56E-02 | 2.60E-02 | 1.42E-02 | 1.11E-05 | 2.34E-06 | 2.84E-05 | 5.98E-06 |
| 30 - 35 | 1.68E-02 | 0. | 2.00E-02 | 2.20E-02 | 1.23E-02 | 3.48E-02 | 1.05E-02 | 3.43E-06 | 0. | 6.53E-06 | 1.37E-06 |
| 35 - 40 | 1.56E-02 | 0. | 1.74E-02 | 1.99E-02 | 1.12E-02 | 2.18E-02 | 8.54E-03 | 1.69E-06 | 0. | 2.12E-06 | 0. |
| 40 - 45 | 1.25E-02 | 0. | 1.33E-02 | 1.57E-02 | 9.36E-03 | 1.74E-02 | 6.59E-03 | 0. | 0. | 0. | 0. |
| 45 - 50 | 8.30E-03 | 0. | 8.78E-03 | 1.08E-02 | 6.51E-03 | 1.16E-02 | 4.70E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 1.35E-03 | 0. | 1.42E-03 | 1.66E-03 | 1.26E-03 | 1.71E-03 | 1.18E-03 | 0. | 0. | 0. | 0. |
| 70 -100 | 2.65E-05 | 0. | 2.74E-05 | 3.12E-05 | 2.73E-05 | 3.17E-05 | 3.00E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.81E-02 | 3.18E-02 |
| MARITIME | 4.83E-03 | 1.20E-02 | 5.27E-02 | 1.31E-01 |
| TROPOSPHERIC | 2.88E-03 | 4.01E-04 | ******** | ******** |

WAVELENGTH = 9.282440 MICROMETERS
FREQUENCY = 1077.303 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.44E-01 | 0. | 4.03E-01 | 2.85E-01 | 9.57E-02 | 1.87E-01 | 5.81E-02 | 5.60E-03 | 3.71E-03 | 6.10E-02 | 4.04E-02 |
| 0 - 1 | 1.29E-01 | 0. | 3.24E-01 | 2.32E-01 | 8.82E-02 | 1.58E-01 | 5.91E-02 | 3.70E-03 | 2.46E-03 | 6.10E-02 | 4.04E-02 |
| 1 - 2 | 1.04E-01 | 0. | 2.21E-01 | 1.60E-01 | 7.65E-02 | 1.20E-01 | 5.76E-02 | 7.36E-04 | 1.01E-04 | 1.17E-02 | 1.62E-03 |
| 2 - 3 | 8.48E-02 | 0. | 1.48E-01 | 1.13E-01 | 6.74E-02 | 9.50E-02 | 5.22E-02 | 3.76E-04 | 5.19E-05 | 1.98E-03 | 2.74E-04 |
| 3 - 4 | 6.99E-02 | 0. | 1.05E-01 | 9.20E-02 | 5.82E-02 | 7.88E-02 | 4.61E-02 | 3.07E-04 | 4.23E-05 | 1.08E-03 | 1.50E-04 |
| 4 - 5 | 5.82E-02 | 0. | 8.40E-02 | 7.62E-02 | 4.91E-02 | 6.58E-02 | 3.89E-02 | 2.36E-04 | 3.26E-05 | 5.64E-04 | 7.78E-05 |
| 5 - 6 | 4.87E-02 | 0. | 7.08E-02 | 6.51E-02 | 4.14E-02 | 5.51E-02 | 3.18E-02 | 1.75E-04 | 2.42E-05 | 3.58E-04 | 4.93E-05 |
| 6 - 7 | 4.05E-02 | 0. | 5.92E-02 | 5.65E-02 | 3.48E-02 | 4.45E-02 | 2.57E-02 | 1.21E-04 | 1.67E-05 | 2.93E-04 | 4.04E-05 |
| 7 - 8 | 3.36E-02 | 0. | 4.92E-02 | 4.70E-02 | 2.90E-02 | 3.66E-02 | 2.05E-02 | 7.67E-05 | 1.06E-05 | 1.96E-04 | 2.70E-05 |
| 8 - 9 | 2.75E-02 | 0. | 4.17E-02 | 3.90E-02 | 2.40E-02 | 2.97E-02 | 1.73E-02 | 1.07E-04 | 0. | 6.81E-05 | 1.40E-05 |
| 9 - 10 | 2.23E-02 | 0. | 3.41E-02 | 3.24E-02 | 1.96E-02 | 2.38E-02 | 1.62E-02 | 7.99E-05 | 0. | 4.97E-05 | 1.02E-05 |
| 10 - 11 | 1.78E-02 | 0. | 2.80E-02 | 2.64E-02 | 1.75E-02 | 2.13E-02 | 1.62E-02 | 6.81E-05 | 0. | 5.37E-05 | 1.10E-05 |
| 11 - 12 | 1.59E-02 | 0. | 2.23E-02 | 2.15E-02 | 1.72E-02 | 2.12E-02 | 1.63E-02 | 6.25E-05 | 0. | 6.19E-05 | 1.27E-05 |
| 12 - 13 | 1.58E-02 | 0. | 1.85E-02 | 1.72E-02 | 1.69E-02 | 2.12E-02 | 1.62E-02 | 5.83E-05 | 0. | 7.12E-05 | 1.46E-05 |
| 13 - 14 | 1.58E-02 | 0. | 1.36E-02 | 1.54E-02 | 1.65E-02 | 2.13E-02 | 1.62E-02 | 5.75E-05 | 0. | 7.73E-05 | 1.59E-05 |
| 14 - 15 | 1.58E-02 | 0. | 1.11E-02 | 1.60E-02 | 1.63E-02 | 2.18E-02 | 1.63E-02 | 5.65E-05 | 0. | 7.90E-05 | 1.62E-05 |
| 15 - 16 | 1.58E-02 | 0. | 8.47E-03 | 1.55E-02 | 1.60E-02 | 2.05E-02 | 1.60E-02 | 5.83E-05 | 0. | 7.69E-05 | 1.58E-05 |
| 16 - 17 | 1.57E-02 | 0. | 6.63E-03 | 1.52E-02 | 1.56E-02 | 2.13E-02 | 1.57E-02 | 5.64E-05 | 0. | 7.06E-05 | 1.45E-05 |
| 17 - 18 | 1.58E-02 | 0. | 7.07E-03 | 1.54E-02 | 1.55E-02 | 2.11E-02 | 1.53E-02 | 5.28E-05 | 0. | 6.18E-05 | 1.27E-05 |
| 18 - 19 | 1.57E-02 | 0. | 8.49E-03 | 1.56E-02 | 1.51E-02 | 2.12E-02 | 1.50E-02 | 4.78E-05 | 0. | 5.16E-05 | 1.06E-05 |
| 19 - 20 | 1.57E-02 | 0. | 9.94E-03 | 1.62E-02 | 1.48E-02 | 2.13E-02 | 1.46E-02 | 4.15E-05 | 0. | 4.14E-05 | 8.49E-06 |
| 20 - 21 | 1.60E-02 | 0. | 1.18E-02 | 1.67E-02 | 1.51E-02 | 2.10E-02 | 1.42E-02 | 3.51E-05 | 0. | 3.30E-05 | 6.78E-06 |
| 21 - 22 | 1.66E-02 | 0. | 1.38E-02 | 1.74E-02 | 1.50E-02 | 2.11E-02 | 1.39E-02 | 2.93E-05 | 0. | 2.64E-05 | 5.41E-06 |
| 22 - 23 | 1.72E-02 | 0. | 1.52E-02 | 1.80E-02 | 1.49E-02 | 2.11E-02 | 1.36E-02 | 2.43E-05 | 0. | 2.05E-05 | 4.21E-06 |
| 23 - 24 | 1.78E-02 | 0. | 1.64E-02 | 1.97E-02 | 1.47E-02 | 2.14E-02 | 1.33E-02 | 1.95E-05 | 0. | 1.59E-05 | 3.26E-06 |
| 24 - 25 | 1.85E-02 | 0. | 1.78E-02 | 1.99E-02 | 1.54E-02 | 2.25E-02 | 1.30E-02 | 1.54E-05 | 0. | 1.25E-05 | 2.57E-06 |
| 25 - 30 | 1.95E-02 | 0. | 2.11E-02 | 2.31E-02 | 1.43E-02 | 2.49E-02 | 1.34E-02 | 1.10E-05 | 2.33E-06 | 2.82E-05 | 5.96E-06 |
| 30 - 35 | 1.60E-02 | 0. | 1.91E-02 | 2.11E-02 | 1.16E-02 | 3.35E-02 | 9.86E-03 | 3.40E-06 | 0. | 6.48E-06 | 1.37E-06 |
| 35 - 40 | 1.49E-02 | 0. | 1.67E-02 | 1.91E-02 | 1.06E-02 | 2.08E-02 | 8.07E-03 | 1.67E-06 | 0. | 2.10E-06 | 0. |
| 40 - 45 | 1.20E-02 | 0. | 1.28E-02 | 1.52E-02 | 8.97E-03 | 1.69E-02 | 6.27E-03 | 0. | 0. | 0. | 0. |
| 45 - 50 | 8.81E-03 | 0. | 8.48E-03 | 1.09E-02 | 6.27E-03 | 1.12E-02 | 4.50E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 1.28E-03 | 0. | 1.35E-03 | 1.60E-03 | 1.20E-03 | 1.63E-03 | 1.13E-03 | 0. | 0. | 0. | 0. |
| 70 -100 | 2.47E-05 | 0. | 2.55E-05 | 2.91E-05 | 2.55E-05 | 2.95E-05 | 2.82E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.45E-02 | 3.18E-02 |
| MARITIME | 4.86E-03 | 1.21E-02 | 5.29E-02 | 1.31E-01 |
| TROPOSPHERIC | 2.93E-03 | 4.04E-04 | ******** | ******** |

WAVELENGTH = 9.271355 MICROMETERS
FREQUENCY = 1078.591 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | CLEAR $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.39E-01 | 0. | 4.00E-01 | 2.61E-01 | 9.16E-02 | 1.83E-01 | 5.46E-02 | 5.66E-03 | 3.71E-03 | 6.16E-02 | 4.04E-02 |
| 0 - 1 | 1.24E-01 | 0. | 3.20E-01 | 2.28E-01 | 8.41E-02 | 1.54E-01 | 5.55E-02 | 3.75E-03 | 2.45E-03 | 6.16E-02 | 4.04E-02 |
| 1 - 2 | 9.97E-02 | 0. | 2.17E-01 | 1.56E-01 | 7.25E-02 | 1.15E-01 | 5.41E-02 | 7.50E-04 | 1.02E-04 | 1.19E-02 | 1.63E-03 |
| 2 - 3 | 8.06E-02 | 0. | 1.44E-01 | 1.14E-01 | 6.36E-02 | 9.09E-02 | 4.89E-02 | 3.83E-04 | 5.24E-05 | 2.02E-03 | 2.76E-04 |
| 3 - 4 | 6.60E-02 | 0. | 1.01E-01 | 8.77E-02 | 5.46E-02 | 7.47E-02 | 4.30E-02 | 3.13E-04 | 4.27E-05 | 1.11E-03 | 1.51E-04 |
| 4 - 5 | 5.46E-02 | 0. | 7.97E-02 | 7.21E-02 | 4.59E-02 | 6.20E-02 | 3.61E-02 | 2.41E-04 | 3.29E-05 | 5.75E-04 | 7.85E-05 |
| 5 - 6 | 4.54E-02 | 0. | 6.68E-02 | 6.13E-02 | 3.86E-02 | 5.16E-02 | 2.93E-02 | 1.79E-04 | 2.44E-05 | 3.64E-04 | 4.98E-05 |
| 6 - 7 | 3.77E-02 | 0. | 5.56E-02 | 5.30E-02 | 3.23E-02 | 4.16E-02 | 2.36E-02 | 1.24E-04 | 1.69E-05 | 2.98E-04 | 4.07E-05 |
| 7 - 8 | 3.11E-02 | 0. | 4.60E-02 | 4.39E-02 | 2.69E-02 | 3.40E-02 | 1.89E-02 | 7.82E-05 | 1.07E-05 | 2.00E-04 | 2.73E-05 |
| 8 - 9 | 2.54E-02 | 0. | 3.88E-02 | 3.64E-02 | 2.23E-02 | 2.76E-02 | 1.61E-02 | 1.07E-04 | 0. | 6.79E-05 | 1.40E-05 |
| 9 - 10 | 2.06E-02 | 0. | 3.16E-02 | 3.02E-02 | 1.84E-02 | 2.22E-02 | 1.55E-02 | 7.95E-05 | 0. | 4.96E-05 | 1.02E-05 |
| 10 - 11 | 1.67E-02 | 0. | 2.59E-02 | 2.46E-02 | 1.67E-02 | 2.01E-02 | 1.60E-02 | 6.77E-05 | 0. | 5.36E-05 | 1.11E-05 |
| 11 - 12 | 1.51E-02 | 0. | 2.06E-02 | 2.02E-02 | 1.68E-02 | 2.03E-02 | 1.68E-02 | 6.21E-05 | 0. | 6.17E-05 | 1.27E-05 |
| 12 - 13 | 1.52E-02 | 0. | 1.70E-02 | 1.63E-02 | 1.70E-02 | 2.06E-02 | 1.75E-02 | 5.80E-05 | 0. | 7.10E-05 | 1.47E-05 |
| 13 - 14 | 1.54E-02 | 0. | 1.25E-02 | 1.49E-02 | 1.71E-02 | 2.12E-02 | 1.81E-02 | 5.72E-05 | 0. | 7.71E-05 | 1.59E-05 |
| 14 - 15 | 1.57E-02 | 0. | 1.02E-02 | 1.57E-02 | 1.73E-02 | 2.21E-02 | 1.89E-02 | 5.82E-05 | 0. | 7.87E-05 | 1.63E-05 |
| 15 - 16 | 1.61E-02 | 0. | 7.88E-03 | 1.56E-02 | 1.74E-02 | 2.14E-02 | 1.96E-02 | 5.80E-05 | 0. | 7.67E-05 | 1.58E-05 |
| 16 - 17 | 1.66E-02 | 0. | 6.33E-03 | 1.57E-02 | 1.76E-02 | 2.27E-02 | 2.00E-02 | 5.61E-05 | 0. | 7.04E-05 | 1.45E-05 |
| 17 - 18 | 1.71E-02 | 0. | 6.97E-03 | 1.63E-02 | 1.79E-02 | 2.32E-02 | 2.00E-02 | 5.25E-05 | 0. | 6.17E-05 | 1.27E-05 |
| 18 - 19 | 1.77E-02 | 0. | 8.64E-03 | 1.71E-02 | 1.79E-02 | 2.35E-02 | 1.98E-02 | 4.76E-05 | 0. | 5.14E-05 | 1.06E-05 |
| 19 - 20 | 1.80E-02 | 0. | 1.05E-02 | 1.81E-02 | 1.80E-02 | 2.37E-02 | 1.92E-02 | 4.12E-05 | 0. | 4.13E-05 | 8.52E-06 |
| 20 - 21 | 1.85E-02 | 0. | 1.28E-02 | 1.88E-02 | 1.82E-02 | 2.31E-02 | 1.84E-02 | 3.49E-05 | 0. | 3.29E-05 | 6.80E-06 |
| 21 - 22 | 1.90E-02 | 0. | 1.51E-02 | 1.96E-02 | 1.79E-02 | 2.28E-02 | 1.74E-02 | 2.92E-05 | 0. | 2.63E-05 | 5.43E-06 |
| 22 - 23 | 1.93E-02 | 0. | 1.67E-02 | 1.99E-02 | 1.74E-02 | 2.23E-02 | 1.64E-02 | 2.42E-05 | 0. | 2.05E-05 | 4.23E-06 |
| 23 - 24 | 1.95E-02 | 0. | 1.79E-02 | 2.11E-02 | 1.66E-02 | 2.23E-02 | 1.53E-02 | 1.94E-05 | 0. | 1.58E-05 | 3.27E-06 |
| 24 - 25 | 1.97E-02 | 0. | 1.90E-02 | 2.08E-02 | 1.68E-02 | 2.29E-02 | 1.43E-02 | 1.53E-05 | 0. | 1.25E-05 | 2.58E-06 |
| 25 - 30 | 1.94E-02 | 0. | 2.11E-02 | 2.28E-02 | 1.40E-02 | 2.41E-02 | 1.33E-02 | 1.09E-05 | 2.33E-06 | 2.80E-05 | 5.95E-06 |
| 30 - 35 | 1.51E-02 | 0. | 1.81E-02 | 1.99E-02 | 1.10E-02 | 3.14E-02 | 9.27E-03 | 3.38E-06 | 0. | 6.43E-06 | 1.37E-06 |
| 35 - 40 | 1.39E-02 | 0. | 1.56E-02 | 1.79E-02 | 9.87E-03 | 1.95E-02 | 7.45E-03 | 1.66E-06 | 0. | 2.08E-06 | 0. |
| 40 - 45 | 1.13E-02 | 0. | 1.20E-02 | 1.43E-02 | 8.36E-03 | 1.59E-02 | 5.79E-03 | 0. | 0. | 0. | 0. |
| 45 - 50 | 7.53E-03 | 0. | 7.96E-03 | 9.86E-03 | 5.87E-03 | 1.86E-02 | 4.19E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 1.19E-03 | 0. | 1.25E-03 | 1.48E-03 | 1.11E-03 | 1.51E-03 | 1.05E-03 | 0. | 0. | 0. | 0. |
| 70 -100 | 2.22E-05 | 0. | 2.30E-05 | 2.62E-05 | 2.31E-05 | 2.65E-05 | 2.57E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | CLEAR $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.89E-02 | 3.18E-02 |
| MARITIME | 4.88E-03 | 1.21E-02 | 5.31E-02 | 1.32E-01 |
| TROPOSPHERIC | 2.99E-03 | 4.08E-04 | ******** | ******** |

WAVELENGTH = 4.793117 MICROMETERS
FREQUENCY = 2086.325 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.44E-01 | 0. | 4.65E-01 | 3.63E-01 | 2.80E-01 | 2.79E-01 | 1.70E-01 | 1.46E-03 | 5.42E-03 | 1.59E-02 | 5.91E-02 |
| 0 - 1 | 2.26E-01 | 0. | 3.87E-01 | 3.13E-01 | 1.92E-01 | 2.50E-01 | 1.70E-01 | 9.68E-04 | 3.59E-03 | 1.59E-02 | 5.91E-02 |
| 1 - 2 | 1.99E-01 | 0. | 2.90E-01 | 2.45E-01 | 1.80E-01 | 2.12E-01 | 1.67E-01 | 1.14E-04 | 1.59E-04 | 1.82E-03 | 2.69E-03 |
| 2 - 3 | 1.82E-01 | 0. | 2.28E-01 | 2.07E-01 | 1.71E-01 | 1.90E-01 | 1.63E-01 | 5.83E-05 | 8.65E-05 | 3.07E-04 | 4.56E-04 |
| 3 - 4 | 1.71E-01 | 0. | 1.92E-01 | 1.82E-01 | 1.64E-01 | 1.77E-01 | 1.58E-01 | 4.75E-05 | 7.05E-05 | 1.68E-04 | 2.49E-04 |
| 4 - 5 | 1.63E-01 | 0. | 1.75E-01 | 1.71E-01 | 1.58E-01 | 1.67E-01 | 1.53E-01 | 3.66E-05 | 5.43E-05 | 8.74E-05 | 1.30E-04 |
| 5 - 6 | 1.57E-01 | 0. | 1.67E-01 | 1.64E-01 | 1.54E-01 | 1.62E-01 | 1.48E-01 | 2.72E-05 | 4.03E-05 | 5.54E-05 | 8.22E-05 |
| 6 - 7 | 1.52E-01 | 0. | 1.60E-01 | 1.62E-01 | 1.49E-01 | 1.54E-01 | 1.43E-01 | 1.88E-05 | 2.79E-05 | 4.53E-05 | 6.73E-05 |
| 7 - 8 | 1.48E-01 | 0. | 1.55E-01 | 1.55E-01 | 1.45E-01 | 1.50E-01 | 1.38E-01 | 1.19E-05 | 1.76E-05 | 3.03E-05 | 4.50E-05 |
| 8 - 9 | 1.44E-01 | 0. | 1.53E-01 | 1.50E-01 | 1.41E-01 | 1.45E-01 | 1.35E-01 | 5.06E-05 | 2.16E-06 | 8.24E-05 | 3.57E-05 |
| 9 - 10 | 1.39E-01 | 0. | 1.46E-01 | 1.46E-01 | 1.37E-01 | 1.41E-01 | 1.34E-01 | 3.77E-05 | 1.61E-06 | 6.02E-06 | 2.61E-05 |
| 10 - 11 | 1.35E-01 | 0. | 1.44E-01 | 1.41E-01 | 1.35E-01 | 1.39E-01 | 1.34E-01 | 3.21E-05 | 1.37E-06 | 6.50E-06 | 2.82E-05 |
| 11 - 12 | 1.32E-01 | 0. | 1.37E-01 | 1.38E-01 | 1.35E-01 | 1.38E-01 | 1.34E-01 | 2.95E-05 | 1.26E-06 | 7.48E-06 | 3.24E-05 |
| 12 - 13 | 1.32E-01 | 0. | 1.37E-01 | 1.33E-01 | 1.34E-01 | 1.38E-01 | 1.34E-01 | 2.75E-05 | 1.17E-06 | 8.62E-06 | 3.74E-05 |
| 13 - 14 | 1.32E-01 | 0. | 1.25E-01 | 1.31E-01 | 1.33E-01 | 1.39E-01 | 1.33E-01 | 2.71E-05 | 1.16E-06 | 9.35E-06 | 4.06E-05 |
| 14 - 15 | 1.32E-01 | 0. | 1.26E-01 | 1.36E-01 | 1.33E-01 | 1.42E-01 | 1.34E-01 | 2.76E-05 | 1.18E-06 | 9.55E-06 | 4.14E-05 |
| 15 - 16 | 1.32E-01 | 0. | 1.21E-01 | 1.32E-01 | 1.32E-01 | 1.33E-01 | 1.33E-01 | 2.75E-05 | 1.17E-06 | 9.30E-06 | 4.03E-05 |
| 16 - 17 | 1.31E-01 | 0. | 1.12E-01 | 1.30E-01 | 1.31E-01 | 1.38E-01 | 1.32E-01 | 2.66E-05 | 1.13E-06 | 8.54E-06 | 3.70E-05 |
| 17 - 18 | 1.31E-01 | 0. | 1.15E-01 | 1.31E-01 | 1.32E-01 | 1.37E-01 | 1.32E-01 | 2.49E-05 | 1.06E-06 | 7.48E-06 | 3.24E-05 |
| 18 - 19 | 1.31E-01 | 0. | 1.19E-01 | 1.30E-01 | 1.30E-01 | 1.37E-01 | 1.31E-01 | 2.26E-05 | 0. | 6.24E-06 | 2.71E-05 |
| 19 - 20 | 1.31E-01 | 0. | 1.21E-01 | 1.31E-01 | 1.29E-01 | 1.38E-01 | 1.30E-01 | 1.96E-05 | 0. | 5.01E-06 | 2.17E-05 |
| 20 - 21 | 1.31E-01 | 0. | 1.26E-01 | 1.31E-01 | 1.31E-01 | 1.36E-01 | 1.29E-01 | 1.66E-05 | 0. | 4.00E-06 | 1.73E-05 |
| 21 - 22 | 1.32E-01 | 0. | 1.29E-01 | 1.33E-01 | 1.30E-01 | 1.37E-01 | 1.29E-01 | 1.38E-05 | 0. | 3.19E-06 | 1.38E-05 |
| 22 - 23 | 1.32E-01 | 0. | 1.29E-01 | 1.31E-01 | 1.30E-01 | 1.36E-01 | 1.28E-01 | 1.15E-05 | 0. | 2.48E-06 | 1.08E-05 |
| 23 - 24 | 1.33E-01 | 0. | 1.30E-01 | 1.37E-01 | 1.28E-01 | 1.36E-01 | 1.28E-01 | 9.21E-06 | 0. | 1.92E-06 | 8.33E-06 |
| 24 - 25 | 1.34E-01 | 0. | 1.33E-01 | 1.34E-01 | 1.34E-01 | 1.37E-01 | 1.27E-01 | 7.25E-06 | 0. | 1.51E-06 | 6.57E-06 |
| 25 - 30 | 1.29E-01 | 0. | 1.31E-01 | 1.33E-01 | 1.24E-01 | 1.34E-01 | 1.22E-01 | 1.09E-05 | 1.11E-05 | 2.79E-05 | 2.83E-05 |
| 30 - 35 | 4.34E-02 | 0. | 4.43E-02 | 4.73E-02 | 4.80E-02 | 1.41E-01 | 3.79E-02 | 3.36E-06 | 3.41E-06 | 6.48E-06 | 6.58E-06 |
| 35 - 40 | 2.40E-02 | 0. | 2.40E-02 | 2.68E-02 | 2.15E-02 | 2.72E-02 | 1.95E-02 | 1.65E-06 | 1.68E-06 | 2.08E-06 | 2.11E-06 |
| 40 - 45 | 1.28E-02 | 0. | 1.35E-02 | 1.46E-02 | 1.12E-02 | 1.49E-02 | 9.96E-03 | 0. | 0. | 0. | 0. |
| 45 - 50 | 6.74E-03 | 0. | 7.14E-03 | 7.93E-03 | 5.85E-03 | 8.11E-03 | 5.09E-03 | 0. | 0. | 0. | 0. |
| 50 - 70 | 1.72E-03 | 0. | 1.84E-03 | 2.05E-03 | 1.49E-03 | 2.12E-03 | 1.27E-03 | 0. | 0. | 0. | 0. |
| 70 -100 | 7.48E-05 | 0. | 7.83E-05 | 9.05E-05 | 6.51E-05 | 9.49E-05 | 5.80E-05 | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.36E-02 | 4.56E-02 |
| MARITIME | 2.70E-03 | 2.95E-02 | 2.94E-02 | 3.21E-01 |
| TROPOSPHERIC | 4.54E-04 | 6.74E-04 | ******** | ******** |

WAVELENGTH = 4.863704 MICROMETERS
FREQUENCY = 2056.046 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_{in}$(km$^{-1}$) | U.S. STANDARD $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_{in}$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | AEROSOL CLEAR $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | AEROSOL HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5.26E-02 | 0. | 1.93E-01 | 1.26E-01 | 2.90E-02 | 7.35E-02 | 1.71E-02 | 1.45E-03 | 5.39E-03 | 1.57E-02 | 5.87E-02 |
| 0 - 1 | 4.19E-02 | 0. | 1.48E-01 | 9.76E-02 | 2.42E-02 | 5.69E-02 | 1.54E-02 | 9.57E-04 | 3.57E-03 | 1.57E-02 | 5.87E-02 |
| 1 - 2 | 2.63E-02 | 0. | 8.79E-02 | 5.73E-02 | 1.66E-02 | 3.45E-02 | 1.20E-02 | 1.12E-04 | 1.62E-04 | 1.79E-03 | 2.58E-03 |
| 2 - 3 | 1.61E-02 | 0. | 4.76E-02 | 3.09E-02 | 1.16E-02 | 2.11E-02 | 8.88E-03 | 5.74E-05 | 8.27E-05 | 3.02E-04 | 4.36E-04 |
| 3 - 4 | 9.95E-03 | 0. | 2.18E-02 | 1.64E-02 | 7.78E-03 | 1.29E-02 | 6.41E-03 | 4.68E-05 | 6.74E-05 | 1.65E-04 | 2.38E-04 |
| 4 - 5 | 6.38E-03 | 0. | 1.13E-02 | 9.11E-03 | 5.27E-03 | 7.89E-03 | 4.59E-03 | 3.60E-05 | 5.19E-05 | 8.60E-05 | 1.24E-04 |
| 5 - 6 | 4.29E-03 | 0. | 6.85E-03 | 5.54E-03 | 3.74E-03 | 4.94E-03 | 3.34E-03 | 2.67E-05 | 3.86E-05 | 5.45E-05 | 7.86E-05 |
| 6 - 7 | 3.01E-03 | 0. | 4.16E-03 | 3.72E-03 | 2.70E-03 | 3.21E-03 | 2.48E-03 | 1.85E-05 | 2.67E-05 | 4.46E-05 | 6.43E-05 |
| 7 - 8 | 2.18E-03 | 0. | 2.72E-03 | 2.54E-03 | 1.99E-03 | 2.24E-03 | 1.85E-03 | 1.17E-05 | 1.69E-05 | 2.98E-05 | 4.31E-05 |
| 8 - 9 | 1.60E-03 | 0. | 1.90E-03 | 1.80E-03 | 1.49E-03 | 1.61E-03 | 1.37E-03 | 5.00E-06 | 2.00E-06 | 8.29E-06 | 3.38E-05 |
| 9 - 10 | 1.18E-03 | 0. | 1.35E-03 | 1.33E-03 | 1.11E-03 | 1.20E-03 | 1.01E-03 | 3.72E-05 | 1.49E-06 | 6.06E-06 | 2.47E-05 |
| 10 - 11 | 8.82E-04 | 0. | 1.01E-03 | 9.76E-04 | 8.27E-04 | 8.93E-04 | 7.37E-04 | 3.17E-05 | 1.27E-06 | 6.54E-06 | 2.67E-05 |
| 11 - 12 | 6.51E-04 | 0. | 7.47E-04 | 7.34E-04 | 6.09E-04 | 6.57E-04 | 5.41E-04 | 2.91E-05 | 1.17E-06 | 7.53E-06 | 3.07E-05 |
| 12 - 13 | 4.75E-04 | 0. | 5.77E-04 | 5.47E-04 | 4.47E-04 | 4.84E-04 | 3.94E-04 | 2.72E-05 | 1.09E-06 | 8.67E-06 | 3.53E-05 |
| 13 - 14 | 3.47E-04 | 0. | 4.09E-04 | 4.04E-04 | 3.26E-04 | 3.61E-04 | 2.88E-04 | 2.68E-05 | 1.07E-06 | 9.42E-06 | 3.83E-05 |
| 14 - 15 | 2.54E-04 | 0. | 3.18E-04 | 3.05E-04 | 2.40E-04 | 2.71E-04 | 2.12E-04 | 2.72E-05 | 1.09E-06 | 9.61E-06 | 3.92E-05 |
| 15 - 16 | 1.86E-04 | 0. | 2.31E-04 | 2.15E-04 | 1.76E-04 | 1.89E-04 | 1.54E-04 | 2.72E-05 | 1.09E-06 | 9.36E-06 | 3.81E-05 |
| 16 - 17 | 1.35E-04 | 0. | 1.59E-04 | 1.55E-04 | 1.28E-04 | 1.45E-04 | 1.13E-04 | 2.63E-05 | 1.05E-06 | 8.60E-06 | 3.50E-05 |
| 17 - 18 | 9.92E-05 | 0. | 1.15E-04 | 1.14E-04 | 9.45E-05 | 1.07E-04 | 8.25E-05 | 2.46E-05 | 0. | 7.53E-06 | 3.07E-05 |
| 18 - 19 | 7.25E-05 | 0. | 8.14E-05 | 8.29E-05 | 6.85E-05 | 7.93E-05 | 6.03E-05 | 2.23E-05 | 0. | 6.28E-06 | 2.56E-05 |
| 19 - 20 | 5.30E-05 | 0. | 5.71E-05 | 6.04E-05 | 4.98E-05 | 5.90E-05 | 4.40E-05 | 1.93E-05 | 0. | 5.04E-06 | 2.05E-05 |
| 20 - 21 | 3.87E-05 | 0. | 4.12E-05 | 4.44E-05 | 3.69E-05 | 4.23E-05 | 3.21E-05 | 1.63E-05 | 0. | 4.02E-06 | 1.64E-05 |
| 21 - 22 | 2.83E-05 | 0. | 2.95E-05 | 3.27E-05 | 2.67E-05 | 3.20E-05 | 2.34E-05 | 1.37E-05 | 0. | 3.21E-06 | 1.31E-05 |
| 22 - 23 | 2.06E-05 | 0. | 2.11E-05 | 2.35E-05 | 1.94E-05 | 2.36E-05 | 1.70E-05 | 1.13E-05 | 0. | 2.50E-06 | 1.02E-05 |
| 23 - 24 | 1.51E-05 | 0. | 1.54E-05 | 1.80E-05 | 1.40E-05 | 1.75E-05 | 1.24E-05 | 9.09E-06 | 0. | 1.93E-06 | 7.85E-06 |
| 24 - 25 | 1.11E-05 | 0. | 1.14E-05 | 1.28E-05 | 1.47E-05 | 1.29E-05 | 9.01E-06 | 7.16E-06 | 0. | 1.52E-06 | 6.21E-06 |
| 25 - 30 | 4.85E-06 | 0. | 4.91E-06 | 5.72E-06 | 4.41E-06 | 5.74E-06 | 3.80E-06 | 1.08E-05 | 1.09E-05 | 2.77E-06 | 2.80E-05 |
| 30 - 35 | 1.34E-06 | 0. | 1.34E-06 | 1.61E-06 | 1.15E-06 | 1.33E-06 | 0. | 3.33E-06 | 3.37E-06 | 6.35E-06 | 6.42E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.64E-06 | 1.66E-06 | 2.06E-06 | 2.08E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | CLEAR $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.29E-02 | 4.53E-02 |
| MARITIME | 2.65E-03 | 2.91E-02 | 2.38E-02 | 3.17E-01 |
| TROPOSPHERIC | 4.47E-04 | 6.44E-04 | ******** | ******** |

WAVELENGTH = 4.925727 MICROMETERS
FREQUENCY = 2030.157 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.11E-01 | 0. | 4.49E-01 | 2.93E-01 | 5.74E-02 | 1.70E-01 | 1.44E-02 | 1.43E-03 | 5.36E-03 | 1.56E-02 | 5.84E-02 |
| 0 - 1 | 8.62E-02 | 0. | 3.36E-01 | 2.24E-01 | 4.16E-02 | 1.28E-01 | 1.40E-02 | 9.47E-04 | 3.55E-03 | 1.56E-02 | 5.84E-02 |
| 1 - 2 | 5.86E-02 | 0. | 1.98E-01 | 1.25E-01 | 2.59E-02 | 7.37E-02 | 1.12E-02 | 1.11E-04 | 1.55E-04 | 1.76E-03 | 2.49E-03 |
| 2 - 3 | 2.75E-02 | 0. | 1.02E-01 | 6.31E-02 | 1.55E-02 | 4.17E-02 | 7.26E-03 | 5.65E-05 | 7.95E-05 | 2.98E-04 | 4.19E-04 |
| 3 - 4 | 1.40E-02 | 0. | 5.16E-02 | 2.97E-02 | 7.97E-03 | 2.23E-02 | 4.09E-03 | 4.61E-05 | 6.48E-05 | 1.63E-04 | 2.29E-04 |
| 4 - 5 | 6.83E-03 | 0. | 1.88E-02 | 1.36E-02 | 3.68E-03 | 1.13E-02 | 1.84E-03 | 3.55E-05 | 4.99E-05 | 8.48E-05 | 1.19E-04 |
| 5 - 6 | 3.26E-03 | 0. | 9.59E-03 | 6.27E-03 | 1.70E-03 | 5.18E-03 | 7.34E-04 | 2.64E-05 | 3.71E-05 | 5.37E-05 | 7.56E-05 |
| 6 - 7 | 1.51E-03 | 0. | 4.37E-03 | 3.12E-03 | 6.75E-04 | 2.23E-03 | 3.11E-04 | 1.82E-05 | 2.56E-05 | 4.40E-05 | 6.18E-05 |
| 7 - 8 | 6.83E-04 | 0. | 1.98E-03 | 1.48E-03 | 2.33E-04 | 8.88E-04 | 1.02E-04 | 1.15E-05 | 1.62E-05 | 2.94E-05 | 4.14E-05 |
| 8 - 9 | 2.67E-04 | 0. | 7.82E-04 | 6.80E-04 | 8.91E-05 | 2.83E-04 | 3.88E-05 | 4.95E-05 | 1.87E-06 | 8.34E-06 | 3.21E-05 |
| 9 - 10 | 8.89E-05 | 0. | 2.88E-04 | 3.04E-04 | 3.89E-05 | 8.33E-05 | 2.52E-05 | 3.68E-05 | 1.39E-06 | 6.09E-06 | 2.35E-05 |
| 10 - 11 | 3.45E-05 | 0. | 9.35E-05 | 1.12E-04 | 2.31E-05 | 3.64E-05 | 1.63E-05 | 3.14E-05 | 1.19E-06 | 6.58E-06 | 2.53E-05 |
| 11 - 12 | 1.64E-05 | 0. | 3.08E-05 | 3.31E-05 | 1.74E-05 | 2.20E-05 | 1.09E-05 | 2.68E-05 | 1.09E-06 | 7.57E-06 | 2.92E-05 |
| 12 - 13 | 9.08E-06 | 0. | 1.24E-05 | 1.17E-05 | 9.95E-06 | 1.15E-05 | 7.30E-06 | 2.69E-05 | 1.02E-06 | 8.72E-06 | 3.36E-05 |
| 13 - 14 | 5.50E-06 | 0. | 6.33E-06 | 6.37E-06 | 5.39E-05 | 6.28E-06 | 4.81E-06 | 2.65E-05 | 1.00E-06 | 9.47E-06 | 3.65E-05 |
| 14 - 15 | 3.73E-06 | 0. | 4.36E-06 | 4.47E-06 | 3.67E-06 | 4.35E-06 | 3.27E-06 | 2.70E-05 | 1.02E-06 | 9.67E-06 | 3.72E-05 |
| 15 - 16 | 2.72E-06 | 0. | 3.02E-06 | 3.12E-06 | 2.63E-06 | 3.02E-06 | 2.33E-06 | 2.69E-05 | 1.02E-06 | 9.42E-06 | 3.63E-05 |
| 16 - 17 | 1.98E-06 | 0. | 2.05E-06 | 2.26E-06 | 1.91E-06 | 2.30E-06 | 1.70E-06 | 2.60E-05 | 0. | 8.65E-06 | 3.33E-05 |
| 17 - 18 | 1.45E-06 | 0. | 1.49E-06 | 1.67E-06 | 1.41E-06 | 1.71E-06 | 1.25E-06 | 2.43E-05 | 0. | 7.57E-06 | 2.92E-05 |
| 18 - 19 | 1.06E-06 | 0. | 1.10E-06 | 1.25E-06 | 1.04E-06 | 1.29E-06 | 0. | 2.20E-05 | 0. | 6.32E-06 | 2.43E-05 |
| 19 - 20 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.91E-05 | 0. | 5.07E-06 | 1.95E-05 |
| 20 - 21 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.62E-05 | 0. | 4.05E-06 | 1.56E-05 |
| 21 - 22 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.35E-05 | 0. | 3.23E-06 | 1.24E-05 |
| 22 - 23 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.12E-05 | 0. | 2.51E-06 | 9.68E-06 |
| 23 - 24 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 9.00E-06 | 0. | 1.95E-06 | 7.49E-06 |
| 24 - 25 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 7.38E-06 | 0. | 1.53E-06 | 5.90E-06 |
| 25 - 30 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.07E-05 | 1.08E-05 | 2.74E-05 | 2.77E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.31E-06 | 3.33E-06 | 6.30E-06 | 6.35E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.63E-06 | 1.64E-06 | 2.04E-06 | 2.06E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.23E-02 | 4.50E-02 |
| MARITIME | 2.60E-03 | 2.67E-02 | 2.83E-02 | 3.15E-01 |
| TROPOSPHERIC | 4.40E-04 | 6.19E-04 | ******** | ******** |

WAVELENGTH = 4.989181 MICROMETERS
FREQUENCY = 2004.337 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.15E-02 | 0. | 3.62E-01 | 2.43E-01 | 4.46E-02 | 1.41E-01 | 1.26E-02 | 1.42E-03 | 5.34E-03 | 1.54E-02 | 5.81E-02 |
| 0 - 1 | 7.04E-02 | 0. | 2.73E-01 | 1.82E-01 | 3.49E-02 | 1.05E-01 | 1.20E-02 | 9.37E-04 | 3.53E-03 | 1.54E-02 | 5.81E-02 |
| 1 - 2 | 4.05E-02 | 0. | 1.56E-01 | 9.91E-02 | 2.12E-02 | 5.90E-02 | 9.33E-03 | 1.09E-04 | 1.49E-04 | 1.74E-03 | 2.38E-03 |
| 2 - 3 | 2.18E-02 | 0. | 7.88E-02 | 4.89E-02 | 1.25E-02 | 3.29E-02 | 5.96E-03 | 5.57E-05 | 7.63E-05 | 2.94E-04 | 4.02E-04 |
| 3 - 4 | 1.09E-02 | 0. | 3.15E-02 | 2.27E-02 | 6.33E-03 | 1.73E-02 | 3.32E-03 | 4.54E-05 | 6.22E-05 | 1.61E-04 | 2.20E-04 |
| 4 - 5 | 5.32E-03 | 0. | 1.41E-02 | 1.03E-02 | 2.92E-03 | 8.67E-03 | 1.50E-03 | 3.50E-05 | 4.79E-05 | 8.35E-05 | 1.14E-04 |
| 5 - 6 | 2.54E-03 | 0. | 7.20E-03 | 4.74E-03 | 1.36E-03 | 3.98E-03 | 6.08E-04 | 2.60E-05 | 3.56E-05 | 5.30E-05 | 7.25E-05 |
| 6 - 7 | 1.19E-03 | 0. | 3.29E-03 | 2.37E-03 | 5.49E-04 | 1.73E-03 | 2.66E-04 | 1.80E-05 | 2.46E-05 | 4.33E-05 | 5.93E-05 |
| 7 - 8 | 5.49E-04 | 0. | 1.45E-03 | 1.14E-03 | 1.99E-04 | 7.03E-04 | 9.37E-05 | 1.14E-05 | 1.56E-05 | 2.90E-05 | 3.97E-05 |
| 8 - 9 | 2.22E-04 | 0. | 6.08E-04 | 5.32E-04 | 8.14E-05 | 2.34E-04 | 3.92E-05 | 4.89E-05 | 1.74E-06 | 8.39E-06 | 3.04E-05 |
| 9 - 10 | 7.93E-05 | 0. | 2.32E-04 | 2.45E-04 | 3.86E-05 | 7.48E-05 | 2.62E-05 | 3.64E-05 | 1.29E-06 | 6.12E-06 | 2.22E-05 |
| 10 - 11 | 3.35E-05 | 0. | 8.12E-05 | 9.50E-05 | 2.39E-05 | 3.55E-05 | 1.77E-05 | 3.10E-05 | 1.10E-06 | 6.62E-06 | 2.40E-05 |
| 11 - 12 | 1.73E-05 | 0. | 3.02E-05 | 3.18E-05 | 1.80E-05 | 2.24E-05 | 1.22E-05 | 2.85E-05 | 1.01E-06 | 7.62E-06 | 2.77E-05 |
| 12 - 13 | 1.03E-05 | 0. | 1.39E-05 | 1.31E-05 | 1.10E-05 | 1.29E-05 | 8.45E-06 | 2.66E-05 | 0. | 8.77E-06 | 3.19E-05 |
| 13 - 14 | 6.69E-06 | 0. | 7.49E-06 | 7.68E-06 | 6.54E-06 | 7.90E-06 | 5.80E-06 | 2.62E-05 | 0. | 9.52E-06 | 3.46E-05 |
| 14 - 15 | 4.69E-06 | 0. | 5.03E-06 | 5.58E-06 | 4.58E-06 | 5.69E-06 | 4.07E-06 | 2.67E-05 | 0. | 9.72E-06 | 3.53E-05 |
| 15 - 16 | 3.44E-06 | 0. | 3.28E-06 | 3.93E-06 | 3.31E-06 | 3.97E-06 | 2.93E-06 | 2.66E-05 | 0. | 9.47E-06 | 3.44E-05 |
| 16 - 17 | 2.52E-06 | 0. | 2.11E-06 | 2.85E-06 | 2.41E-06 | 3.06E-06 | 2.14E-06 | 2.57E-05 | 0. | 8.69E-06 | 3.16E-05 |
| 17 - 18 | 1.85E-06 | 0. | 1.57E-06 | 2.12E-06 | 1.77E-06 | 2.27E-06 | 1.56E-06 | 2.41E-05 | 0. | 7.62E-06 | 2.76E-05 |
| 18 - 19 | 1.37E-06 | 0. | 1.21E-06 | 1.57E-06 | 1.30E-06 | 1.70E-06 | 1.15E-06 | 2.18E-05 | 0. | 6.35E-06 | 2.31E-05 |
| 19 - 20 | 1.02E-06 | 0. | 0. | 1.19E-06 | 0. | 1.29E-06 | 0. | 1.89E-05 | 0. | 5.19E-06 | 1.85E-05 |
| 20 - 21 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.60E-05 | 0. | 4.07E-06 | 1.48E-05 |
| 21 - 22 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.34E-05 | 0. | 3.25E-06 | 1.18E-05 |
| 22 - 23 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.11E-05 | 0. | 2.53E-06 | 9.18E-06 |
| 23 - 24 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 8.90E-06 | 0. | 1.96E-06 | 7.10E-06 |
| 24 - 25 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 7.00E-06 | 0. | 1.54E-06 | 5.60E-06 |
| 25 - 30 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.06E-05 | 1.07E-05 | 2.72E-05 | 2.74E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.28E-06 | 3.30E-06 | 5.25E-06 | 6.29E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.61E-06 | 1.62E-06 | 2.03E-06 | 2.03E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.18E-02 | 4.47E-02 |
| MARITIME | 2.55E-03 | 2.84E-02 | 2.78E-02 | 3.09E-01 |
| TROPOSPHERIC | 4.34E-04 | 5.94E-04 | ******** | ******** |

WAVELENGTH = 4.972449 MICROMETERS
FREQUENCY = 2011.082 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.54E-01 | 0. | 5.89E-01 | 4.02E-01 | 7.70E-02 | 2.36E-01 | 2.20E-02 | 1.42E-03 | 5.34E-03 | 1.55E-02 | 5.82E-02 |
| 0 - 1 | 1.19E-01 | 0. | 4.48E-01 | 3.04E-01 | 6.06E-02 | 1.79E-01 | 2.10E-02 | 9.39E-04 | 3.54E-03 | 1.55E-02 | 5.82E-02 |
| 1 - 2 | 6.99E-02 | 0. | 2.62E-01 | 1.68E-01 | 3.71E-02 | 1.02E-01 | 1.63E-02 | 1.09E-04 | 1.51E-04 | 1.74E-03 | 2.40E-03 |
| 2 - 3 | 3.80E-02 | 0. | 1.34E-01 | 8.39E-02 | 2.19E-02 | 5.72E-02 | 1.05E-02 | 5.59E-05 | 7.71E-05 | 2.95E-04 | 4.06E-04 |
| 3 - 4 | 1.93E-02 | 0. | 5.43E-02 | 3.94E-02 | 1.11E-02 | 3.04E-02 | 5.80E-03 | 4.56E-05 | 6.29E-05 | 1.61E-04 | 2.22E-04 |
| 4 - 5 | 9.39E-03 | 0. | 2.47E-02 | 1.80E-02 | 5.12E-03 | 1.53E-02 | 2.59E-03 | 3.51E-05 | 4.84E-05 | 8.39E-05 | 1.16E-04 |
| 5 - 6 | 4.48E-03 | 0. | 1.27E-02 | 8.36E-03 | 2.35E-03 | 7.06E-03 | 1.01E-03 | 2.61E-05 | 3.60E-05 | 5.32E-05 | 7.33E-05 |
| 6 - 7 | 2.07E-03 | 0. | 5.81E-03 | 4.17E-03 | 9.17E-04 | 3.05E-03 | 4.15E-04 | 1.80E-05 | 2.49E-05 | 4.35E-05 | 6.00E-05 |
| 7 - 8 | 9.32E-04 | 0. | 2.55E-03 | 1.99E-03 | 3.84E-04 | 1.21E-03 | 1.23E-04 | 1.14E-05 | 1.57E-05 | 2.91E-05 | 4.01E-05 |
| 8 - 9 | 3.57E-04 | 0. | 1.04E-03 | 9.10E-04 | 1.07E-04 | 3.76E-04 | 3.85E-05 | 4.91E-05 | 1.77E-06 | 8.37E-06 | 3.09E-05 |
| 9 - 10 | 1.11E-04 | 0. | 3.79E-04 | 4.04E-04 | 4.13E-05 | 1.02E-04 | 2.36E-05 | 3.65E-05 | 1.32E-06 | 6.12E-06 | 2.26E-05 |
| 10 - 11 | 3.82E-05 | 0. | 1.17E-04 | 1.43E-04 | 2.26E-05 | 4.01E-05 | 1.42E-05 | 3.11E-05 | 1.12E-06 | 6.61E-06 | 2.44E-05 |
| 11 - 12 | 1.54E-05 | 0. | 3.37E-05 | 3.73E-05 | 1.71E-05 | 2.26E-05 | 8.81E-06 | 2.86E-05 | 1.03E-06 | 7.61E-06 | 2.80E-05 |
| 12 - 13 | 7.06E-06 | 0. | 1.03E-05 | 9.83E-05 | 8.58E-06 | 9.92E-06 | 5.50E-06 | 2.67E-05 | 0. | 8.76E-06 | 3.23E-05 |
| 13 - 14 | 3.53E-06 | 0. | 4.04E-06 | 4.09E-06 | 3.60E-06 | 4.19E-06 | 3.27E-06 | 2.63E-05 | 0. | 9.51E-06 | 3.51E-05 |
| 14 - 15 | 2.16E-06 | 0. | 2.43E-06 | 2.59E-06 | 2.23E-06 | 2.63E-06 | 2.02E-06 | 2.67E-05 | 0. | 9.71E-06 | 3.58E-05 |
| 15 - 16 | 1.58E-06 | 0. | 1.59E-06 | 1.79E-06 | 1.56E-06 | 1.81E-06 | 1.42E-06 | 2.67E-05 | 0. | 9.45E-06 | 3.49E-05 |
| 16 - 17 | 1.15E-06 | 0. | 1.06E-06 | 1.30E-06 | 1.14E-06 | 1.37E-06 | 1.03E-06 | 2.58E-05 | 0. | 8.68E-06 | 3.20E-05 |
| 17 - 18 | 0. | 0. | 0. | 0. | 0. | 1.02E-06 | 0. | 2.42E-05 | 0. | 7.60E-06 | 2.80E-05 |
| 18 - 19 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 2.19E-05 | 0. | 6.34E-06 | 2.34E-05 |
| 19 - 20 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.90E-05 | 0. | 5.09E-06 | 1.88E-05 |
| 20 - 21 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.60E-05 | 0. | 4.06E-06 | 1.50E-05 |
| 21 - 22 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.34E-05 | 0. | 3.24E-06 | 1.20E-05 |
| 22 - 23 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.11E-05 | 0. | 2.53E-06 | 9.31E-06 |
| 23 - 24 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 8.92E-06 | 0. | 1.95E-06 | 7.20E-06 |
| 24 - 25 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 7.02E-06 | 0. | 1.54E-06 | 5.68E-06 |
| 25 - 30 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.07E-05 | 1.07E-05 | 2.73E-05 | 2.74E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.29E-06 | 3.31E-06 | 6.27E-06 | 6.30E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.62E-06 | 1.63E-06 | 2.03E-06 | 2.04E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.19E-02 | 4.48E-02 |
| MARITIME | 2.56E-03 | 2.85E-02 | 2.79E-02 | 3.10E-01 |
| TROPOSPHERIC | 4.36E-04 | 6.01E-04 | ******** | ******** |

WAVELENGTH = 5.043465 MICROMETERS
FREQUENCY = 1982.764 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.13E-01 | 0. | 7.84E-01 | 5.43E-01 | 1.98E-01 | 3.27E-01 | 3.11E-02 | 1.44E-03 | 5.28E-03 | 1.57E-02 | 5.75E-02 |
| 0 - 1 | 1.71E-01 | 0. | 6.18E-01 | 4.26E-01 | 8.74E-02 | 2.54E-01 | 3.06E-02 | 9.53E-04 | 3.50E-03 | 1.57E-02 | 5.75E-02 |
| 1 - 2 | 1.07E-01 | 0. | 3.90E-01 | 2.53E-01 | 5.74E-02 | 1.56E-01 | 2.55E-02 | 1.12E-04 | 1.44E-04 | 1.78E-03 | 2.30E-03 |
| 2 - 3 | 6.31E-02 | 0. | 2.17E-01 | 1.38E-01 | 3.66E-02 | 9.47E-02 | 1.77E-02 | 5.71E-05 | 7.37E-05 | 3.01E-04 | 3.89E-04 |
| 3 - 4 | 3.47E-02 | 0. | 9.63E-02 | 7.04E-02 | 2.02E-02 | 5.48E-02 | 1.06E-02 | 4.66E-05 | 6.01E-05 | 1.65E-04 | 2.13E-04 |
| 4 - 5 | 1.84E-02 | 0. | 4.77E-02 | 3.50E-02 | 1.01E-02 | 3.01E-02 | 5.13E-03 | 3.59E-05 | 4.63E-05 | 8.56E-05 | 1.11E-04 |
| 5 - 6 | 9.51E-03 | 0. | 2.66E-02 | 1.76E-02 | 5.02E-03 | 1.50E-02 | 2.16E-03 | 2.66E-05 | 3.44E-05 | 5.43E-05 | 7.01E-05 |
| 6 - 7 | 4.76E-03 | 0. | 1.32E-02 | 9.51E-03 | 2.11E-03 | 7.03E-03 | 9.52E-04 | 1.84E-05 | 2.38E-05 | 4.44E-05 | 5.73E-05 |
| 7 - 8 | 2.30E-03 | 0. | 6.23E-03 | 4.88E-03 | 7.42E-04 | 2.99E-03 | 2.93E-04 | 1.16E-05 | 1.50E-05 | 2.87E-05 | 3.84E-05 |
| 8 - 9 | 9.37E-04 | 0. | 2.73E-03 | 2.39E-03 | 2.71E-04 | 9.88E-04 | 8.89E-05 | 5.06E-05 | 1.67E-06 | 8.54E-06 | 2.94E-05 |
| 9 - 10 | 3.02E-04 | 0. | 1.05E-03 | 1.13E-03 | 1.05E-04 | 2.76E-04 | 5.62E-05 | 3.77E-05 | 1.24E-06 | 6.24E-06 | 2.15E-05 |
| 10 - 11 | 1.03E-04 | 0. | 3.34E-04 | 4.15E-04 | 5.81E-05 | 1.09E-04 | 3.43E-05 | 3.21E-05 | 1.06E-06 | 6.74E-06 | 2.32E-05 |
| 11 - 12 | 4.00E-05 | 0. | 9.48E-05 | 1.07E-04 | 4.64E-05 | 6.27E-05 | 2.12E-05 | 2.95E-05 | 0. | 7.76E-06 | 2.67E-05 |
| 12 - 13 | 1.67E-05 | 0. | 2.53E-05 | 2.43E-05 | 2.23E-05 | 2.60E-05 | 1.30E-05 | 2.75E-05 | 0. | 8.93E-06 | 3.07E-05 |
| 13 - 14 | 7.08E-06 | 0. | 7.77E-06 | 8.03E-06 | 7.65E-06 | 9.06E-06 | 7.16E-06 | 2.71E-05 | 0. | 9.69E-06 | 3.33E-05 |
| 14 - 15 | [illegible]E-06 | 0. | 3.88E-06 | 4.55E-06 | 4.29E-06 | 5.15E-06 | 4.03E-06 | 2.76E-05 | 0. | 9.90E-06 | 3.41E-05 |
| 15 - 16 | [illegible]E-06 | 0. | 2.35E-06 | 3.17E-06 | 2.96E-06 | 3.61E-06 | 2.79E-06 | 2.75E-05 | 0. | 9.64E-06 | 3.32E-05 |
| 16 - 17 | 2.[illegible]E-06 | 0. | 1.57E-06 | 2.37E-06 | 2.18E-06 | 2.71E-06 | 2.05E-06 | 2.66E-05 | 0. | 8.85E-06 | 3.04E-05 |
| 17 - 18 | 1.55E-06 | 0. | 1.22E-06 | 1.82E-06 | 1.65E-06 | 2.09E-06 | 1.55E-06 | 2.49E-05 | 0. | 7.75E-06 | 2.67E-05 |
| 18 - 19 | 1.23E-06 | 0. | 1.06E-06 | 1.48E-06 | 1.32E-06 | 1.69E-06 | 1.23E-06 | 2.25E-05 | 0. | 6.47E-06 | 2.23E-05 |
| 19 - 20 | 1.06E-06 | 0. | 0. | 1.23E-06 | 1.07E-06 | 1.39E-06 | 0. | 1.95E-05 | 0. | 5.19E-06 | 1.79E-05 |
| 20 - 21 | 0. | 0. | 0. | 1.10E-06 | 0. | 1.22E-06 | 0. | 1.65E-05 | 0. | 4.14E-06 | 1.42E-05 |
| 21 - 22 | 0. | 0. | 0. | 1.03E-06 | 0. | 1.12E-06 | 0. | 1.38E-05 | 0. | 3.31E-06 | 1.14E-05 |
| 22 - 23 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.15E-05 | 0. | 2.57E-06 | 8.86E-06 |
| 23 - 24 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 9.20E-06 | 0. | 1.99E-06 | 6.85E-06 |
| 24 - 25 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 7.24E-06 | 0. | 1.57E-06 | 5.40E-06 |
| 25 - 30 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.05E-05 | 1.06E-05 | 2.70E-05 | 2.71E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.25E-06 | 3.26E-06 | 6.19E-06 | 6.22E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.60E-06 | 1.60E-06 | 2.01E-06 | 2.01E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.15E-02 | 4.43E-02 |
| MARITIME | 2.51E-03 | 2.79E-02 | 2.74E-02 | 3.04E-01 |
| TROPOSPHERIC | 4.45E-04 | 5.74E-04 | ******** | ******** |

WAVELENGTH = 5.054114 MICROMETERS
FREQUENCY = 1978.586 WAVENUMBER

| ht(km) | U.S. STANDARD $\alpha_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\alpha_m$(km$^{-1}$) | MIDLAT SUMMER $\alpha_m$(km$^{-1}$) | MIDLAT WINTER $\alpha_m$(km$^{-1}$) | SUBARCTIC SUMMER $\alpha_m$(km$^{-1}$) | SUBARCTIC WINTER $\alpha_m$(km$^{-1}$) | AEROSOL CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.36E-02 | 0. | 3.09E-01 | 2.14E-01 | 4.44E-02 | 1.30E-01 | 1.36E-02 | 1.45E-03 | 5.27E-03 | 1.58E-02 | 5.74E-02 |
| 0 - 1 | 6.53E-02 | 0. | 2.36E-01 | 1.62E-01 | 3.50E-02 | 9.79E-02 | 1.28E-02 | 9.58E-04 | 3.49E-03 | 1.58E-02 | 5.74E-02 |
| 1 - 2 | 3.84E-02 | 0. | 1.39E-01 | 8.99E-02 | 2.15E-02 | 5.62E-02 | 9.94E-03 | 1.12E-04 | 1.43E-04 | 1.79E-03 | 2.28E-03 |
| 2 - 3 | 2.15E-02 | 0. | 7.17E-02 | 4.55E-02 | 1.28E-02 | 3.20E-02 | 6.42E-03 | 5.75E-05 | 7.33E-05 | 3.03E-04 | 3.86E-04 |
| 3 - 4 | 1.11E-02 | 0. | 2.95E-02 | 2.18E-02 | 6.66E-03 | 1.73E-02 | 3.63E-03 | 4.69E-05 | 5.97E-05 | 1.66E-04 | 2.11E-04 |
| 4 - 5 | 5.58E-03 | 0. | 1.37E-02 | 1.02E-02 | 3.15E-03 | 8.90E-03 | 1.68E-03 | 3.61E-05 | 4.60E-05 | 8.62E-05 | 1.10E-04 |
| 5 - 6 | 2.74E-03 | 0. | 7.23E-03 | 4.85E-03 | 1.50E-03 | 4.22E-03 | 6.95E-04 | 2.68E-05 | 3.42E-05 | 5.46E-05 | 6.96E-05 |
| 6 - 7 | 1.32E-03 | 0. | 3.41E-03 | 2.49E-03 | 6.20E-04 | 1.89E-03 | 3.06E-04 | 1.85E-05 | 2.36E-05 | 4.47E-05 | 5.70E-05 |
| 7 - 8 | 6.21E-04 | 0. | 1.56E-03 | 1.23E-03 | 2.25E-04 | 7.87E-04 | 1.04E-04 | 1.17E-05 | 1.49E-05 | 2.99E-05 | 3.81E-05 |
| 8 - 9 | 2.54E-04 | 0. | 6.69E-04 | 5.90E-04 | 9.83E-05 | 2.66E-04 | 3.99E-05 | 5.10E-05 | 1.66E-06 | 8.57E-06 | 2.92E-05 |
| 9 - 10 | 8.89E-05 | 0. | 2.60E-04 | 2.77E-04 | 4.04E-05 | 8.31E-05 | 2.56E-05 | 3.90E-05 | 1.23E-06 | 6.26E-06 | 2.13E-05 |
| 10 - 11 | 3.53E-05 | 0. | 9.07E-05 | 1.07E-04 | 2.39E-05 | 3.76E-05 | 1.67E-05 | 3.24E-05 | 1.05E-06 | 6.77E-06 | 2.30E-05 |
| 11 - 12 | 1.67E-05 | 0. | 3.19E-05 | 3.39E-05 | 1.78E-05 | 2.30E-05 | 1.11E-05 | 2.97E-05 | 0. | 7.79E-06 | 2.65E-05 |
| 12 - 13 | 9.23E-06 | 0. | 1.30E-05 | 1.22E-05 | 1.03E-05 | 1.25E-05 | 7.48E-06 | 2.77E-05 | 0. | 8.97E-06 | 3.05E-05 |
| 13 - 14 | 5.62E-06 | 0. | 6.15E-06 | 6.44E-06 | 5.60E-06 | 7.18E-06 | 4.95E-06 | 2.73E-05 | 0. | 9.73E-06 | 3.31E-05 |
| 14 - 15 | 3.82E-06 | 0. | 3.72E-06 | 4.52E-06 | 3.80E-06 | 5.05E-06 | 3.38E-06 | 2.78E-05 | 0. | 9.94E-06 | 3.38E-05 |
| 15 - 16 | 2.79E-06 | 0. | 2.23E-06 | 3.16E-06 | 2.71E-06 | 3.51E-06 | 2.40E-06 | 2.77E-05 | 0. | 9.66E-06 | 3.29E-05 |
| 16 - 17 | 2.04E-06 | 0. | 1.37E-06 | 2.29E-06 | 1.96E-06 | 2.69E-06 | 1.74E-06 | 2.68E-05 | 0. | 8.89E-06 | 3.02E-05 |
| 17 - 18 | 1.49E-06 | 0. | 1.03E-06 | 1.70E-06 | 1.43E-06 | 1.99E-06 | 1.26E-06 | 2.51E-05 | 0. | 7.79E-06 | 2.65E-05 |
| 18 - 19 | 1.11E-06 | 0. | 0. | 1.28E-06 | 1.05E-06 | 1.50E-06 | 0. | 2.27E-05 | 0. | 6.50E-06 | 2.21E-05 |
| 19 - 20 | 0. | 0. | 0. | 0. | 0. | 1.14E-06 | 0. | 1.97E-05 | 0. | 5.21E-06 | 1.77E-05 |
| 20 - 21 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.67E-05 | 0. | 4.16E-06 | 1.42E-05 |
| 21 - 22 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.40E-05 | 0. | 3.32E-06 | 1.13E-05 |
| 22 - 23 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.16E-05 | 0. | 2.59E-06 | 8.80E-06 |
| 23 - 24 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 9.28E-06 | 0. | 2.00E-06 | 6.81E-06 |
| 24 - 25 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 7.31E-06 | 0. | 1.58E-06 | 5.36E-06 |
| 25 - 30 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.05E-05 | 1.06E-05 | 2.69E-05 | 2.70E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.24E-06 | 3.26E-06 | 6.18E-06 | 6.21E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.59E-06 | 1.60E-06 | 2.00E-06 | 2.01E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\alpha_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.15E-02 | 4.42E-02 |
| MARITIME | 2.51E-03 | 2.78E-02 | 2.73E-02 | 3.03E-01 |
| TROPOSPHERIC | 4.48E-04 | 5.71E-04 | ******** | ******** |

WAVELENGTH = 5.064891 MICROMETERS
FREQUENCY = 1974.376 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | U.S. STANDARD $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | AEROSOL CLEAR $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | AEROSOL HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.25E-01 | 0. | 4.51E-01 | 3.20E-01 | 6.62E-02 | 1.94E-01 | 2.01E-02 | 1.45E-03 | 5.26E-03 | 1.58E-02 | 5.73E-02 |
| 0 - 1 | 9.79E-02 | 0. | 3.53E-01 | 2.43E-01 | 5.23E-02 | 1.47E-01 | 1.90E-02 | 9.62E-04 | 3.48E-03 | 1.58E-02 | 5.73E-02 |
| 1 - 2 | 5.86E-02 | 0. | 2.11E-01 | 1.36E-01 | 3.24E-02 | 8.51E-02 | 1.48E-02 | 1.13E-04 | 1.42E-04 | 1.80E-03 | 2.27E-03 |
| 2 - 3 | 3.27E-02 | 0. | 1.10E-01 | 6.97E-02 | 1.94E-02 | 4.89E-02 | 9.62E-03 | 5.79E-05 | 7.28E-05 | 3.05E-04 | 3.83E-04 |
| 3 - 4 | 1.70E-02 | 0. | 4.56E-02 | 3.36E-02 | 1.01E-02 | 2.66E-02 | 5.44E-03 | 4.72E-05 | 5.93E-05 | 1.67E-04 | 2.10E-04 |
| 4 - 5 | 8.54E-03 | 0. | 2.14E-02 | 1.58E-02 | 4.76E-03 | 1.38E-02 | 2.49E-03 | 3.63E-05 | 4.57E-05 | 8.68E-05 | 1.09E-04 |
| 5 - 6 | 4.19E-03 | 0. | 1.13E-02 | 7.51E-03 | 2.25E-03 | 6.51E-03 | 1.00E-03 | 2.70E-05 | 3.39E-05 | 5.50E-05 | 6.92E-05 |
| 6 - 7 | 2.00E-03 | 0. | 5.32E-03 | 3.85E-03 | 9.81E-04 | 2.91E-03 | 4.24E-04 | 1.87E-05 | 2.34E-05 | 4.50E-05 | 5.66E-05 |
| 7 - 8 | 9.26E-04 | 0. | 2.40E-03 | 1.85E-03 | 3.05E-04 | 1.19E-03 | 1.27E-04 | 1.18E-05 | 1.48E-05 | 3.01E-05 | 3.79E-05 |
| 8 - 9 | 3.64E-04 | 0. | 1.01E-03 | 8.89E-04 | 1.09E-04 | 3.80E-04 | 3.81E-05 | 5.15E-05 | 1.64E-06 | 8.61E-06 | 2.90E-05 |
| 9 - 10 | 1.15E-04 | 0. | 3.77E-04 | 4.06E-04 | 4.14E-05 | 1.05E-04 | 2.30E-05 | 3.83E-05 | 1.22E-06 | 6.29E-06 | 2.12E-05 |
| 10 - 11 | 3.94E-05 | 0. | 1.18E-04 | 1.47E-04 | 2.24E-05 | 4.05E-05 | 1.34E-05 | 3.26E-05 | 1.04E-06 | 6.79E-06 | 2.29E-05 |
| 11 - 12 | 1.52E-05 | 0. | 3.38E-05 | 3.79E-05 | 1.71E-05 | 2.23E-05 | 8.05E-06 | 3.00E-05 | 0. | 7.82E-06 | 2.63E-05 |
| 12 - 13 | 6.33E-06 | 0. | 9.46E-05 | 9.11E-06 | 8.10E-06 | 9.21E-06 | 4.84E-06 | 2.80E-05 | 0. | 9.01E-06 | 3.03E-05 |
| 13 - 14 | 2.78E-06 | 0. | 3.17E-05 | 3.22E-06 | 2.92E-06 | 3.40E-06 | 2.69E-06 | 2.75E-05 | 0. | 9.77E-06 | 3.29E-05 |
| 14 - 15 | 1.56E-06 | 0. | 1.69E-05 | 1.87E-06 | 1.68E-06 | 1.99E-06 | 1.55E-06 | 2.80E-05 | 0. | 9.98E-06 | 3.36E-05 |
| 15 - 16 | 1.14E-06 | 0. | 1.05E-06 | 1.28E-06 | 1.15E-06 | 1.37E-06 | 1.07E-06 | 2.79E-05 | 0. | 9.72E-06 | 3.27E-05 |
| 16 - 17 | 0. | 0. | 0. | 0. | 0. | 1.02E-06 | 0. | 2.70E-05 | 0. | 8.92E-06 | 3.00E-05 |
| 17 - 18 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 2.53E-05 | 0. | 7.82E-06 | 2.63E-05 |
| 18 - 19 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 2.29E-05 | 0. | 6.52E-06 | 2.20E-05 |
| 19 - 20 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.99E-05 | 0. | 5.23E-06 | 1.76E-05 |
| 20 - 21 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.68E-05 | 0. | 4.18E-06 | 1.41E-05 |
| 21 - 22 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.41E-05 | 0. | 3.33E-06 | 1.12E-05 |
| 22 - 23 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.17E-05 | 0. | 2.60E-06 | 8.74E-06 |
| 23 - 24 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 9.36E-06 | 0. | 2.01E-06 | 6.76E-06 |
| 24 - 25 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 7.37E-06 | 0. | 1.58E-06 | 5.33E-06 |
| 25 - 30 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.05E-05 | 1.05E-05 | 2.69E-05 | 2.70E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.24E-06 | 3.25E-06 | 6.16E-06 | 6.19E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.59E-06 | 1.60E-06 | 2.00E-06 | 2.01E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | CLEAR $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.14E-02 | 4.41E-02 |
| MARITIME | 2.50E-03 | 2.77E-02 | 2.72E-02 | 3.01E-01 |
| TROPOSPHERIC | 4.51E-04 | 5.67E-04 | ******** | ******** |

WAVELENGTH = 5.120587 MICROMETERS
FREQUENCY = 1952.901 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.90E-01 | 0. | 1.06E+00 | 7.40E-01 | 1.56E-01 | 4.52E-01 | 4.82E-02 | 1.49E-03 | 5.19E-03 | 1.62E-02 | 5.66E-02 |
| 0 - 1 | 2.27E-01 | 0. | 8.12E-01 | 5.62E-01 | 1.23E-01 | 3.41E-01 | 4.55E-02 | 9.85E-04 | 3.44E-03 | 1.62E-02 | 5.66E-02 |
| 1 - 2 | 1.36E-01 | 0. | 4.82E-01 | 3.12E-01 | 7.61E-02 | 1.97E-01 | 3.52E-02 | 1.17E-04 | 1.37E-04 | 1.86E-03 | 2.19E-03 |
| 2 - 3 | 7.55E-02 | 0. | 2.49E-01 | 1.59E-01 | 4.54E-02 | 1.13E-01 | 2.27E-02 | 5.98E-05 | 7.03E-05 | 3.15E-04 | 3.70E-04 |
| 3 - 4 | 3.93E-02 | 0. | 1.03E-01 | 7.63E-02 | 2.35E-02 | 6.10E-02 | 1.28E-02 | 4.88E-05 | 5.73E-05 | 1.72E-04 | 2.02E-04 |
| 4 - 5 | 1.97E-02 | 0. | 4.81E-02 | 3.57E-02 | 1.11E-02 | 3.15E-02 | 5.89E-03 | 3.75E-05 | 4.41E-05 | 8.96E-05 | 1.05E-04 |
| 5 - 6 | 9.70E-03 | 0. | 2.55E-02 | 1.70E-02 | 5.26E-03 | 1.49E-02 | 2.39E-03 | 2.79E-05 | 3.28E-05 | 5.68E-05 | 6.69E-05 |
| 6 - 7 | 4.65E-03 | 0. | 1.20E-02 | 8.73E-03 | 2.12E-03 | 6.70E-03 | 1.02E-03 | 1.93E-05 | 2.26E-05 | 4.65E-05 | 5.46E-05 |
| 7 - 8 | 2.17E-03 | 0. | 5.46E-03 | 4.30E-03 | 7.30E-04 | 2.76E-03 | 3.20E-04 | 1.22E-05 | 1.43E-05 | 3.11E-05 | 3.66E-05 |
| 8 - 9 | 8.64E-04 | 0. | 2.32E-03 | 2.05E-03 | 2.69E-04 | 8.97E-04 | 1.05E-04 | 5.37E-05 | 1.59E-06 | 8.79E-06 | 2.80E-05 |
| 9 - 10 | 2.82E-04 | 0. | 8.76E-04 | 9.44E-04 | 1.09E-04 | 2.56E-04 | 6.54E-05 | 3.99E-05 | 1.18E-06 | 6.42E-06 | 2.04E-05 |
| 10 - 11 | 1.02E-04 | 0. | 2.83E-04 | 3.49E-04 | 6.16E-05 | 1.04E-04 | 3.97E-05 | 3.40E-05 | 1.01E-06 | 6.94E-06 | 2.21E-05 |
| 11 - 12 | 4.29E-05 | 0. | 8.62E-05 | 9.59E-05 | 4.66E-05 | 5.88E-05 | 2.49E-05 | 3.12E-05 | 0. | 7.98E-06 | 2.54E-05 |
| 12 - 13 | 2.01E-05 | 0. | 2.83E-05 | 2.73E-05 | 2.38E-05 | 2.64E-05 | 1.57E-05 | 2.92E-05 | 0. | 9.19E-06 | 2.93E-05 |
| 13 - 14 | 1.03E-05 | 0. | 1.21E-05 | 1.20E-05 | 1.04E-05 | 1.16E-05 | 9.46E-06 | 2.88E-05 | 0. | 9.98E-06 | 3.18E-05 |
| 14 - 15 | 6.44E-06 | 0. | 7.71E-06 | 7.74E-06 | 6.54E-06 | 7.39E-06 | 5.93E-06 | 2.92E-05 | 0. | 1.02E-05 | 3.25E-05 |
| 15 - 16 | 4.70E-06 | 0. | 5.30E-06 | 5.37E-06 | 4.62E-06 | 5.11E-06 | 4.17E-06 | 2.91E-05 | 0. | 9.92E-06 | 3.16E-05 |
| 16 - 17 | 3.42E-06 | 0. | 3.64E-06 | 3.90E-06 | 3.37E-06 | 3.86E-06 | 3.05E-06 | 2.82E-05 | 0. | 9.11E-06 | 2.90E-05 |
| 17 - 18 | 2.49E-06 | 0. | 2.68E-06 | 2.91E-06 | 2.51E-06 | 2.88E-06 | 2.26E-06 | 2.64E-05 | 0. | 7.98E-06 | 2.54E-05 |
| 18 - 19 | 1.88E-06 | 0. | 2.01E-06 | 2.21E-06 | 1.90E-06 | 2.22E-06 | 1.72E-06 | 2.39E-05 | 0. | 6.66E-06 | 2.12E-05 |
| 19 - 20 | 1.49E-06 | 0. | 1.53E-06 | 1.71E-06 | 1.46E-06 | 1.74E-06 | 1.32E-06 | 2.07E-05 | 0. | 5.34E-06 | 1.70E-05 |
| 20 - 21 | 1.21E-06 | 0. | 1.23E-06 | 1.38E-06 | 1.18E-06 | 1.40E-06 | 1.06E-06 | 1.75E-05 | 0. | 4.26E-06 | 1.36E-05 |
| 21 - 22 | 1.02E-06 | 0. | 1.03E-06 | 1.16E-06 | 0. | 1.18E-06 | 0. | 1.47E-05 | 0. | 3.40E-06 | 1.08E-05 |
| 22 - 23 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.22E-05 | 0. | 2.65E-06 | 8.44E-06 |
| 23 - 24 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 9.76E-06 | 0. | 2.05E-06 | 6.53E-06 |
| 24 - 25 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 7.68E-06 | 0. | 1.62E-06 | 5.14E-06 |
| 25 - 30 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.04E-05 | 1.04E-05 | 2.66E-05 | 2.67E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.20E-06 | 3.22E-06 | 6.10E-06 | 6.13E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.57E-06 | 1.58E-06 | 1.98E-06 | 1.99E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.12E-02 | 4.37E-02 |
| MARITIME | 2.46E-03 | 2.71E-02 | 2.68E-02 | 2.96E-01 |
| TROPOSPHERIC | 4.66E-04 | 5.47E-04 | ******** | ******** |

WAVELENGTH = 3.679804 MICROMETERS
FREQUENCY = 2717.536 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_{in}$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 6.82E-02 | 0. | 2.27E-01 | 1.65E-01 | 4.19E-02 | 1.86E-01 | 1.62E-02 | 9.85E-04 | 6.57E-03 | 1.07E-02 | 7.15E-02 |
| 0 - 1 | 5.57E-02 | 0. | 1.80E-01 | 1.29E-01 | 3.42E-02 | 8.29E-02 | 1.51E-02 | 6.52E-04 | 4.35E-03 | 1.07E-02 | 7.15E-02 |
| 1 - 2 | 3.62E-02 | 0. | 1.15E-01 | 7.66E-02 | 2.77E-02 | 5.17E-02 | 1.22E-02 | 7.39E-05 | 3.36E-04 | 1.18E-03 | 5.36E-03 |
| 2 - 3 | 2.21E-02 | 0. | 6.36E-02 | 4.20E-02 | 1.47E-02 | 3.21E-02 | 8.56E-03 | 3.78E-05 | 1.72E-04 | 1.99E-04 | 9.06E-04 |
| 3 - 4 | 1.27E-02 | 0. | 2.84E-02 | 2.20E-02 | 8.45E-03 | 1.89E-02 | 5.41E-03 | 3.08E-05 | 1.40E-04 | 1.09E-04 | 4.96E-04 |
| 4 - 5 | 7.19E-03 | 0. | 1.46E-02 | 1.13E-02 | 4.61E-03 | 1.07E-02 | 3.00E-03 | 2.37E-05 | 1.08E-04 | 5.67E-05 | 2.58E-04 |
| 5 - 6 | 4.06E-03 | 0. | 8.51E-03 | 6.01E-03 | 2.59E-03 | 5.73E-03 | 1.61E-03 | 1.76E-05 | 8.02E-05 | 3.59E-05 | 1.63E-04 |
| 6 - 7 | 2.29E-03 | 0. | 4.51E-03 | 3.48E-03 | 1.35E-03 | 2.99E-03 | 9.55E-04 | 1.22E-05 | 5.54E-05 | 2.94E-05 | 1.34E-04 |
| 7 - 8 | 1.31E-03 | 0. | 2.37E-03 | 1.98E-03 | 6.96E-04 | 1.52E-03 | 5.37E-04 | 7.71E-06 | 3.51E-05 | 1.97E-05 | 8.95E-05 |
| 8 - 9 | 7.07E-04 | 0. | 1.22E-03 | 1.13E-03 | 4.19E-04 | 7.04E-04 | 3.43E-04 | 7.71E-05 | 6.38E-06 | 1.33E-05 | 7.65E-05 |
| 9 - 10 | 3.79E-04 | 0. | 6.14E-04 | 6.55E-04 | 2.82E-04 | 3.60E-04 | 2.49E-04 | 5.74E-05 | 4.75E-06 | 9.74E-06 | 5.59E-05 |
| 10 - 11 | 2.40E-04 | 0. | 3.22E-04 | 3.54E-04 | 2.05E-04 | 2.31E-04 | 1.77E-04 | 4.89E-05 | 4.05E-06 | 1.05E-05 | 6.04E-05 |
| 11 - 12 | 1.62E-04 | 0. | 1.89E-04 | 1.95E-04 | 1.53E-04 | 1.60E-04 | 1.27E-04 | 4.49E-05 | 3.72E-06 | 1.21E-05 | 6.95E-05 |
| 12 - 13 | 1.11E-04 | 0. | 1.33E-04 | 1.28E-04 | 1.06E-04 | 1.09E-04 | 9.09E-05 | 4.19E-05 | 3.47E-06 | 1.40E-05 | 8.00E-05 |
| 13 - 14 | 7.84E-05 | 0. | 9.48E-05 | 9.16E-05 | 7.31E-05 | 7.63E-05 | 6.52E-05 | 4.13E-05 | 3.42E-06 | 1.51E-05 | 8.68E-05 |
| 14 - 15 | 5.65E-05 | 0. | 7.70E-05 | 6.82E-05 | 5.34E-05 | 5.65E-05 | 4.72E-05 | 4.20E-05 | 3.48E-06 | 1.55E-05 | 8.87E-05 |
| 15 - 16 | 4.13E-05 | 0. | 5.96E-05 | 4.80E-05 | 3.91E-05 | 3.93E-05 | 3.43E-05 | 4.19E-05 | 3.47E-06 | 1.51E-05 | 8.64E-05 |
| 16 - 17 | 3.01E-05 | 0. | 4.30E-05 | 3.46E-05 | 2.86E-05 | 3.03E-05 | 2.53E-05 | 4.05E-05 | 3.35E-06 | 1.38E-05 | 7.93E-05 |
| 17 - 18 | 2.21E-05 | 0. | 3.08E-05 | 2.55E-05 | 2.12E-05 | 2.23E-05 | 1.86E-05 | 3.80E-05 | 3.14E-06 | 1.21E-05 | 6.95E-05 |
| 18 - 19 | 1.62E-05 | 0. | 2.10E-05 | 1.85E-05 | 1.55E-05 | 1.66E-05 | 1.37E-05 | 3.44E-05 | 2.85E-06 | 1.01E-05 | 5.79E-05 |
| 19 - 20 | 1.19E-05 | 0. | 1.43E-05 | 1.35E-05 | 1.13E-05 | 1.24E-05 | 1.01E-05 | 2.98E-05 | 2.47E-06 | 8.11E-06 | 4.65E-05 |
| 20 - 21 | 8.72E-06 | 0. | 9.98E-06 | 9.88E-06 | 8.49E-06 | 9.09E-06 | 7.49E-06 | 2.52E-05 | 2.09E-06 | 6.47E-06 | 3.71E-05 |
| 21 - 22 | 6.41E-06 | 0. | 6.99E-06 | 7.31E-06 | 6.23E-06 | 6.85E-06 | 5.57E-06 | 2.11E-05 | 1.75E-06 | 5.17E-06 | 2.96E-05 |
| 22 - 23 | 4.73E-06 | 0. | 4.94E-06 | 5.27E-06 | 4.59E-06 | 5.13E-06 | 4.13E-06 | 1.75E-05 | 1.45E-06 | 4.02E-06 | 2.31E-05 |
| 23 - 24 | 3.51E-06 | 0. | 3.61E-06 | 4.04E-06 | 3.39E-06 | 3.85E-06 | 3.10E-06 | 1.40E-05 | 1.16E-06 | 3.11E-06 | 1.78E-05 |
| 24 - 25 | 2.62E-06 | 0. | 2.71E-06 | 2.96E-06 | 2.66E-06 | 2.89E-06 | 2.34E-06 | 1.10E-05 | 0. | 2.45E-06 | 1.41E-05 |
| 25 - 30 | 1.15E-06 | 0. | 1.14E-06 | 1.29E-06 | 1.12E-06 | 1.27E-06 | 1.00E-06 | 1.10E-05 | 1.47E-05 | 2.61E-05 | 3.76E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.38E-06 | 4.53E-06 | 6.45E-06 | 8.63E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.66E-06 | 2.23E-06 | 2.09E-06 | 2.80E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.10E-06 | 0. | 1.10E-06 |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 6.21E-02 | 5.54E-02 |
| MARITIME | 1.65E-03 | 3.96E-02 | 1.80E-02 | 4.31E-01 |
| TROPOSPHERIC | 2.94E-04 | 1.34E-03 | ******** | ******** |

WAVELENGTH = 3.752064 MICROMETERS
FREQUENCY = 2665.200 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.45E-02 | 0. | 6.11E-02 | 4.89E-02 | 2.03E-02 | 3.48E-02 | 1.43E-02 | 9.44E-04 | 6.53E-03 | 1.03E-02 | 7.11E-02 |
| 0 - 1 | 2.11E-02 | 0. | 4.96E-02 | 3.85E-02 | 1.76E-02 | 2.85E-02 | 1.31E-02 | 6.25E-04 | 4.32E-03 | 1.03E-02 | 7.11E-02 |
| 1 - 2 | 1.57E-02 | 0. | 3.36E-02 | 2.48E-02 | 1.34E-02 | 1.98E-02 | 1.10E-02 | 7.02E-05 | 3.20E-04 | 1.12E-03 | 5.10E-03 |
| 2 - 3 | 1.16E-02 | 0. | 2.07E-02 | 1.58E-02 | 1.02E-02 | 1.41E-02 | 8.96E-03 | 3.59E-05 | 1.64E-04 | 1.83E-04 | 8.57E-04 |
| 3 - 4 | 8.57E-03 | 0. | 1.16E-02 | 1.03E-02 | 7.72E-03 | 1.01E-02 | 7.19E-03 | 2.93E-05 | 1.34E-04 | 1.03E-04 | 4.72E-04 |
| 4 - 5 | 6.53E-03 | 0. | 7.79E-03 | 7.09E-03 | 6.01E-03 | 7.29E-03 | 5.79E-03 | 2.25E-05 | 1.03E-04 | 5.38E-05 | 2.46E-04 |
| 5 - 6 | 5.12E-03 | 0. | 5.85E-03 | 5.26E-03 | 4.83E-03 | 5.47E-03 | 4.75E-03 | 1.67E-05 | 7.64E-05 | 3.41E-05 | 1.55E-04 |
| 6 - 7 | 4.11E-03 | 0. | 4.37E-03 | 4.18E-03 | 3.89E-03 | 4.17E-03 | 3.97E-03 | 1.16E-05 | 5.29E-05 | 2.79E-05 | 1.27E-04 |
| 7 - 8 | 3.34E-03 | 0. | 3.40E-03 | 3.31E-03 | 3.17E-03 | 3.32E-03 | 3.29E-03 | 7.32E-06 | 3.34E-05 | 1.87E-05 | 8.52E-05 |
| 8 - 9 | 2.70E-03 | 0. | 2.73E-03 | 2.66E-03 | 2.61E-03 | 2.65E-03 | 2.68E-03 | 7.11E-05 | 6.02E-06 | 1.22E-05 | 7.23E-05 |
| 9 - 10 | 2.19E-03 | 0. | 2.15E-03 | 2.14E-03 | 2.14E-03 | 2.16E-03 | 2.07E-03 | 5.29E-05 | 4.44E-06 | 8.91E-06 | 5.32E-05 |
| 10 - 11 | 1.79E-03 | 0. | 1.78E-03 | 1.75E-03 | 1.69E-03 | 1.72E-03 | 1.56E-03 | 4.51E-05 | 3.42E-06 | 9.62E-06 | 5.75E-05 |
| 11 - 12 | 1.40E-03 | 0. | 1.43E-03 | 1.43E-03 | 1.28E-03 | 1.29E-03 | 1.17E-03 | 4.14E-05 | 3.50E-06 | 1.11E-05 | 6.62E-05 |
| 12 - 13 | 1.04E-03 | 0. | 1.20E-03 | 1.18E-03 | 9.62E-04 | 9.79E-04 | 8.62E-04 | 3.86E-05 | 3.27E-06 | 1.28E-05 | 7.62E-05 |
| 13 - 14 | 7.69E-04 | 0. | 9.29E-04 | 8.94E-04 | 7.13E-04 | 7.32E-04 | 6.39E-04 | 3.61E-05 | 3.22E-06 | 1.38E-05 | 8.27E-05 |
| 14 - 15 | 5.68E-04 | 0. | 7.45E-04 | 6.84E-04 | 5.34E-04 | 5.55E-04 | 4.73E-04 | 3.67E-05 | 3.28E-06 | 1.41E-05 | 8.45E-05 |
| 15 - 16 | 4.19E-04 | 0. | 6.23E-04 | 4.86E-04 | 3.95E-04 | 3.90E-04 | 3.47E-04 | 3.86E-05 | 3.27E-06 | 1.38E-05 | 8.23E-05 |
| 16 - 17 | 3.07E-04 | 0. | 4.56E-04 | 3.52E-04 | 2.92E-04 | 3.02E-04 | 2.58E-04 | 3.73E-05 | 3.16E-06 | 1.26E-05 | 7.55E-05 |
| 17 - 18 | 2.26E-04 | 0. | 3.28E-04 | 2.61E-04 | 2.17E-04 | 2.23E-04 | 1.90E-04 | 3.50E-05 | 2.96E-06 | 1.11E-05 | 6.62E-05 |
| 18 - 19 | 1.66E-04 | 0. | 2.22E-04 | 1.90E-04 | 1.59E-04 | 1.66E-04 | 1.40E-04 | 3.17E-05 | 2.68E-06 | 9.24E-06 | 5.52E-05 |
| 19 - 20 | 1.21E-04 | 0. | 1.49E-04 | 1.38E-04 | 1.16E-04 | 1.24E-04 | 1.03E-04 | 2.77E-05 | 2.32E-06 | 7.41E-06 | 4.43E-05 |
| 20 - 21 | 8.83E-05 | 0. | 1.03E-04 | 9.98E-05 | 8.61E-05 | 9.03E-05 | 7.59E-05 | 2.32E-05 | 1.97E-06 | 5.92E-06 | 3.53E-05 |
| 21 - 22 | 6.40E-05 | 0. | 7.06E-05 | 7.29E-05 | 6.24E-05 | 6.74E-05 | 5.57E-05 | 1.94E-05 | 1.65E-06 | 4.72E-06 | 2.82E-05 |
| 22 - 23 | 4.63E-05 | 0. | 4.88E-05 | 5.17E-05 | 4.54E-05 | 4.99E-05 | 4.09E-05 | 1.61E-05 | 1.36E-06 | 3.68E-06 | 2.20E-05 |
| 23 - 24 | 3.36E-05 | 0. | 3.49E-05 | 3.89E-05 | 3.29E-05 | 3.67E-05 | 3.00E-05 | 1.29E-05 | 1.09E-06 | 2.85E-06 | 1.70E-05 |
| 24 - 25 | 2.44E-05 | 0. | 2.53E-05 | 2.76E-05 | 2.51E-05 | 2.67E-05 | 2.20E-05 | 1.02E-05 | 0. | 2.24E-06 | 1.34E-05 |
| 25 - 30 | 1.04E-05 | 0. | 1.07E-05 | 1.16E-05 | 1.02E-05 | 1.14E-05 | 9.09E-06 | 1.11E-05 | 1.43E-05 | 2.84E-05 | 3.65E-05 |
| 30 - 35 | 2.15E-06 | 0. | 2.09E-06 | 2.41E-06 | 2.02E-06 | 2.42E-06 | 1.77E-06 | 3.43E-06 | 4.40E-06 | 6.53E-06 | 8.39E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.69E-06 | 2.17E-06 | 2.12E-06 | 2.72E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.07E-06 | 0. | 1.07E-06 |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 6.10E-02 | 5.49E-02 |
| MARITIME | 1.20E-03 | 3.92E-02 | 1.30E-02 | 4.27E-01 |
| TROPOSPHERIC | 7.80E-04 | 1.25E-03 | ******** | ******** |

WAVELENGTH = 3.7300353 MICROMETERS
FREQUENCY = 2680.2837 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3.31E-02 | 0. | 1.14E-01 | 8.63E-02 | 2.85E-02 | 5.94E-02 | 1.50E-02 | 9.54E-04 | 6.64E-03 | 1.04E-02 | 7.12E-02 |
| 0 - 1 | 3.25E-02 | 0. | 9.14E-02 | 6.92E-02 | 2.56E-02 | 4.70E-02 | 1.36E-02 | 6.32E-04 | 4.33E-03 | 1.04E-02 | 7.12E-02 |
| 1 - 2 | 2.92E-02 | 0. | 5.94E-02 | 4.13E-02 | 1.62E-02 | 3.03E-02 | 1.08E-02 | 7.11E-05 | 3.25E-04 | 1.13E-03 | 5.17E-03 |
| 2 - 3 | 1.44E-02 | 0. | 3.38E-02 | 2.37E-02 | 1.10E-02 | 1.96E-02 | 7.96E-03 | 3.64E-05 | 1.66E-04 | 1.92E-04 | 3.75E-04 |
| 3 - 4 | 9.12E-03 | 0. | 1.61E-02 | 1.33E-02 | 7.05E-03 | 1.22E-02 | 5.56E-03 | 2.97E-05 | 1.35E-04 | 1.05E-04 | 4.73E-04 |
| 4 - 5 | 5.41E-03 | 0. | 9.11E-03 | 7.58E-03 | 4.52E-03 | 7.56E-03 | 3.72E-03 | 2.29E-05 | 1.04E-04 | 5.45E-05 | 2.49E-04 |
| 5 - 6 | 3.80E-03 | 0. | 5.83E-03 | 4.69E-03 | 3.04E-03 | 4.64E-03 | 2.56E-03 | 1.70E-05 | 7.75E-05 | 3.46E-05 | 1.59E-04 |
| 6 - 7 | 2.56E-03 | 0. | 3.56E-03 | 3.06E-03 | 2.04E-03 | 2.99E-03 | 1.88E-03 | 1.17E-05 | 5.35E-05 | 2.23E-05 | 1.23E-04 |
| 7 - 8 | 1.79E-03 | 0. | 2.27E-03 | 2.06E-03 | 1.43E-03 | 1.87E-03 | 1.38E-03 | 7.42E-06 | 3.39E-05 | 1.89E-05 | 8.65E-05 |
| 8 - 9 | 1.25E-03 | 0. | 1.49E-03 | 1.42E-03 | 1.07E-03 | 1.23E-03 | 1.04E-03 | 7.27E-05 | 6.12E-06 | 1.25E-05 | 7.33E-05 |
| 9 - 10 | 8.92E-04 | 0. | 9.96E-04 | 1.02E-03 | 8.22E-04 | 8.73E-04 | 7.79E-04 | 5.42E-05 | 4.55E-06 | 9.15E-06 | 5.40E-05 |
| 10 - 11 | 6.77E-04 | 0. | 7.22E-04 | 7.27E-04 | 6.26E-04 | 6.51E-04 | 5.65E-04 | 4.62E-05 | 3.99E-06 | 9.88E-06 | 5.83E-05 |
| 11 - 12 | 5.06E-04 | 0. | 5.35E-04 | 5.37E-04 | 4.65E-04 | 4.75E-04 | 4.14E-04 | 4.24E-05 | 3.57E-06 | 1.14E-05 | 6.71E-05 |
| 12 - 13 | 3.66E-04 | 0. | 4.28E-04 | 4.13E-04 | 3.40E-04 | 3.45E-04 | 3.01E-04 | 3.95E-05 | 3.33E-06 | 1.31E-05 | 7.73E-05 |
| 13 - 14 | 2.66E-04 | 0. | 3.23E-04 | 3.11E-04 | 2.46E-04 | 2.55E-04 | 2.20E-04 | 3.90E-05 | 3.23E-06 | 1.42E-05 | 8.39E-05 |
| 14 - 15 | 1.94E-04 | 0. | 2.68E-04 | 2.34E-04 | 1.82E-04 | 1.91E-04 | 1.61E-04 | 3.96E-05 | 3.34E-06 | 1.45E-05 | 8.57E-05 |
| 15 - 16 | 1.42E-04 | 0. | 2.10E-04 | 1.65E-04 | 1.34E-04 | 1.33E-04 | 1.17E-04 | 3.95E-05 | 3.33E-06 | 1.41E-05 | 8.36E-05 |
| 16 - 17 | 1.04E-04 | 0. | 1.52E-04 | 1.19E-04 | 9.83E-05 | 1.03E-04 | 8.67E-05 | 3.82E-05 | 3.22E-06 | 1.30E-05 | 7.66E-05 |
| 17 - 18 | 7.59E-05 | 0. | 1.09E-04 | 8.79E-05 | 7.28E-05 | 7.55E-05 | 6.34E-05 | 3.54E-05 | 3.01E-06 | 1.14E-05 | 6.71E-05 |
| 18 - 19 | 5.55E-05 | 0. | 7.37E-05 | 6.36E-05 | 5.31E-05 | 5.60E-05 | 4.69E-05 | 3.24E-05 | 2.73E-06 | 9.49E-06 | 5.60E-05 |
| 19 - 20 | 4.06E-05 | 0. | 4.95E-05 | 4.62E-05 | 3.87E-05 | 4.17E-05 | 3.45E-05 | 2.91E-05 | 2.37E-06 | 7.61E-06 | 4.49E-05 |
| 20 - 21 | 2.96E-05 | 0. | 3.42E-05 | 3.34E-05 | 2.83E-05 | 3.14E-05 | 2.54E-05 | 2.38E-05 | 2.01E-06 | 6.08E-06 | 3.59E-05 |
| 21 - 22 | 2.14E-05 | 0. | 2.36E-05 | 2.49E-05 | 2.09E-05 | 2.27E-05 | 1.86E-05 | 1.99E-05 | 1.67E-06 | 4.85E-06 | 2.86E-05 |
| 22 - 23 | 1.56E-05 | 0. | 1.64E-05 | 1.74E-05 | 1.52E-05 | 1.68E-05 | 1.37E-05 | 1.65E-05 | 1.39E-06 | 3.78E-06 | 2.23E-05 |
| 23 - 24 | 1.13E-05 | 0. | 1.17E-05 | 1.31E-05 | 1.10E-05 | 1.24E-05 | 1.01E-05 | 1.32E-05 | 1.11E-06 | 2.92E-06 | 1.72E-05 |
| 24 - 25 | 8.28E-06 | 0. | 8.57E-06 | 9.36E-06 | 8.47E-06 | 9.07E-06 | 7.43E-06 | 1.04E-05 | 0. | 2.30E-06 | 1.35E-05 |
| 25 - 30 | 3.53E-06 | 0. | 3.50E-06 | 3.97E-06 | 3.47E-06 | 3.89E-06 | 3.09E-06 | 7.11E-06 | 1.44E-06 | 2.63E-06 | 3.64E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 5.42E-06 | 4.44E-06 | 6.51E-06 | 8.46E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.68E-06 | 2.19E-06 | 2.11E-06 | 2.74E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.08E-06 | 0. | 1.04E-06 |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 6.13E-02 | 5.51E-02 |
| MARITIME | 1.32E-03 | 3.93E-02 | 1.43E-02 | 4.28E-01 |
| T-CROSPHERIC | 2.83E-04 | 1.29E-03 | ******** | ******** |

WAVELENGTH = 3.800706 MICROMETERS
FREQUENCY = 2631.090 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.66E-02 | 0. | 3.22E-02 | 3.00E-02 | 1.32E-02 | 2.19E-02 | 9.47E-03 | 9.59E-04 | 6.47E-03 | 1.04E-02 | 7.05E-02 |
| 0 - 1 | 1.36E-02 | 0. | 3.12E-02 | 2.43E-02 | 1.14E-02 | 1.81E-02 | 8.62E-03 | 6.35E-04 | 4.28E-03 | 1.04E-02 | 7.05E-02 |
| 1 - 2 | 1.04E-02 | 0. | 2.15E-02 | 1.60E-02 | 8.94E-03 | 1.29E-02 | 7.46E-03 | 7.13E-05 | 3.10E-04 | 1.14E-03 | 4.95E-03 |
| 2 - 3 | 7.99E-03 | 0. | 1.36E-02 | 1.08E-02 | 7.19E-03 | 9.58E-03 | 6.40E-03 | 3.65E-05 | 1.59E-04 | 1.92E-04 | 8.37E-04 |
| 3 - 4 | 6.32E-03 | 0. | 9.11E-03 | 7.31E-03 | 5.82E-03 | 7.25E-03 | 5.53E-03 | 2.97E-05 | 1.29E-04 | 1.05E-04 | 4.56E-04 |
| 4 - 5 | 5.27E-03 | 0. | 6.96E-03 | 5.53E-03 | 4.99E-03 | 5.74E-03 | 4.93E-03 | 2.29E-05 | 9.97E-05 | 5.47E-05 | 2.38E-04 |
| 5 - 6 | 4.67E-03 | 0. | 4.95E-03 | 4.61E-03 | 4.51E-03 | 4.84E-03 | 4.57E-03 | 1.70E-05 | 7.40E-05 | 3.47E-05 | 1.51E-04 |
| 6 - 7 | 4.24E-03 | 0. | 4.22E-03 | 4.16E-03 | 4.18E-03 | 4.24E-03 | 4.38E-03 | 1.16E-05 | 5.12E-05 | 2.84E-05 | 1.23E-04 |
| 7 - 8 | 4.00E-03 | 0. | 3.92E-03 | 3.80E-03 | 3.97E-03 | 3.94E-03 | 4.24E-03 | 7.44E-06 | 3.24E-05 | 1.90E-05 | 8.26E-05 |
| 8 - 9 | 3.80E-03 | 0. | 3.60E-03 | 3.57E-03 | 3.83E-03 | 3.73E-03 | 4.06E-03 | 6.96E-05 | 5.76E-06 | 1.15E-05 | 7.02E-05 |
| 9 - 10 | 3.65E-03 | 0. | 3.36E-03 | 3.42E-03 | 3.69E-03 | 3.59E-03 | 3.76E-03 | 5.18E-05 | 4.29E-06 | 8.39E-06 | 5.13E-05 |
| 10 - 11 | 3.51E-03 | 0. | 3.28E-03 | 3.25E-03 | 3.45E-03 | 3.37E-03 | 3.38E-03 | 4.41E-05 | 3.65E-06 | 9.06E-06 | 5.54E-05 |
| 11 - 12 | 3.23E-03 | 0. | 3.09E-03 | 3.12E-03 | 3.08E-03 | 3.00E-03 | 2.99E-03 | 4.05E-05 | 3.35E-06 | 1.04E-05 | 6.38E-05 |
| 12 - 13 | 2.83E-03 | 0. | 3.00E-03 | 2.94E-03 | 2.70E-03 | 2.63E-03 | 2.57E-03 | 3.78E-05 | 3.13E-06 | 1.20E-05 | 7.34E-05 |
| 13 - 14 | 2.42E-03 | 0. | 2.67E-03 | 2.63E-03 | 2.30E-03 | 2.28E-03 | 2.17E-03 | 3.73E-05 | 3.09E-06 | 1.30E-05 | 7.97E-05 |
| 14 - 15 | 2.03E-03 | 0. | 2.57E-03 | 2.50E-03 | 1.94E-03 | 1.95E-03 | 1.80E-03 | 3.79E-05 | 3.14E-06 | 1.33E-05 | 8.14E-05 |
| 15 - 16 | 1.66E-03 | 0. | 2.29E-03 | 1.84E-03 | 1.59E-03 | 1.52E-03 | 1.45E-03 | 3.78E-05 | 3.13E-06 | 1.30E-05 | 7.93E-05 |
| 16 - 17 | 1.32E-03 | 0. | 1.96E-03 | 1.46E-03 | 1.27E-03 | 1.28E-03 | 1.16E-03 | 3.65E-05 | 3.02E-06 | 1.19E-05 | 7.29E-05 |
| 17 - 18 | 1.04E-03 | 0. | 1.46E-03 | 1.17E-03 | 1.01E-03 | 1.02E-03 | 9.09E-04 | 3.42E-05 | 2.83E-06 | 1.04E-05 | 6.39E-05 |
| 18 - 19 | 8.08E-04 | 0. | 1.06E-03 | 9.03E-04 | 7.80E-04 | 7.99E-04 | 7.02E-04 | 3.10E-05 | 2.57E-06 | 8.70E-06 | 5.32E-05 |
| 19 - 20 | 6.17E-04 | 0. | 7.60E-04 | 6.89E-04 | 5.93E-04 | 6.23E-04 | 5.36E-04 | 2.69E-05 | 2.22E-06 | 6.98E-06 | 4.27E-05 |
| 20 - 21 | 4.64E-04 | 0. | 5.37E-04 | 5.17E-04 | 4.54E-04 | 4.69E-04 | 4.05E-04 | 2.27E-05 | 1.88E-06 | 5.57E-06 | 3.41E-05 |
| 21 - 22 | 3.44E-04 | 0. | 3.79E-04 | 3.88E-04 | 3.37E-04 | 3.59E-04 | 3.03E-04 | 1.90E-05 | 1.57E-06 | 4.45E-06 | 2.72E-05 |
| 22 - 23 | 2.53E-04 | 0. | 2.67E-04 | 2.81E-04 | 2.49E-04 | 2.71E-04 | 2.26E-04 | 1.58E-05 | 1.31E-06 | 3.46E-06 | 2.12E-05 |
| 23 - 24 | 1.86E-04 | 0. | 1.93E-04 | 2.14E-04 | 1.82E-04 | 2.02E-04 | 1.67E-04 | 1.26E-05 | 1.05E-06 | 2.68E-06 | 1.64E-05 |
| 24 - 25 | 1.37E-04 | 0. | 1.41E-04 | 1.54E-04 | 1.40E-04 | 1.48E-04 | 1.24E-04 | 9.96E-06 | 0. | 2.11E-06 | 1.29E-05 |
| 25 - 30 | 5.86E-05 | 0. | 5.79E-05 | 6.56E-05 | 5.80E-05 | 6.42E-05 | 5.16E-05 | 1.12E-05 | 1.41E-05 | 2.86E-05 | 3.60E-05 |
| 30 - 35 | 2.18E-05 | 0. | 2.18E-05 | 2.48E-05 | 1.99E-05 | 1.37E-05 | 1.75E-05 | 3.45E-06 | 4.33E-06 | 6.56E-06 | 8.25E-06 |
| 35 - 40 | 5.96E-06 | 0. | 6.31E-06 | 7.19E-06 | 5.10E-06 | 7.31E-06 | 4.41E-06 | 1.69E-06 | 2.13E-06 | 2.13E-06 | 2.67E-06 |
| 40 - 45 | 3.10E-06 | 0. | 2.29E-06 | 2.59E-06 | 1.73E-06 | 2.69E-06 | 1.43E-06 | 0. | 1.35E-06 | 0. | 1.05E-06 |
| 45 - 50 | 0. | 0. | 0. | 1.14E-06 | 0. | 1.18E-06 | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 6.05E-02 | 5.44E-02 |
| MARITIME | 1.23E-03 | 3.87E-02 | 1.34E-02 | 4.22E-01 |
| TROPOSPHERIC | 2.84E-04 | 1.24E-03 | ******** | ******** |

WAVELENGTH = 3.875729 MICROMETERS
FREQUENCY = 2580.160 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | CLEAR $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3.73E-02 | 0. | 5.60E-02 | 4.95E-02 | 3.68E-02 | 4.30E-02 | 3.46E-02 | 9.82E-04 | 6.39E-03 | 1.67E-02 | 6.96E-02 |
| 0 - 1 | 3.31E-02 | 0. | 4.76E-02 | 4.20E-02 | 3.23E-02 | 3.71E-02 | 3.03E-02 | 6.50E-04 | 4.23E-03 | 1.07E-02 | 6.96E-02 |
| 1 - 2 | 2.68E-02 | 0. | 3.58E-02 | 3.11E-02 | 2.60E-02 | 2.89E-02 | 2.49E-02 | 7.30E-05 | 2.36E-04 | 1.16E-03 | 4.71E-03 |
| 2 - 3 | 2.14E-02 | 0. | 2.60E-02 | 2.36E-02 | 2.08E-02 | 2.27E-02 | 2.01E-02 | 7.74E-05 | 1.51E-04 | 1.97E-04 | 7.97E-04 |
| 3 - 4 | 1.70E-02 | 0. | 1.86E-02 | 1.78E-02 | 1.65E-02 | 1.73E-02 | 1.61E-02 | 3.05E-05 | 1.23E-04 | 1.08E-04 | 4.36E-04 |
| 4 - 5 | 1.35E-02 | 0. | 1.43E-02 | 1.38E-02 | 1.31E-02 | 1.39E-02 | 1.24E-02 | 2.35E-05 | 9.50E-05 | 5.60E-05 | 2.27E-04 |
| 5 - 6 | 1.07E-02 | 0. | 1.13E-02 | 1.09E-02 | 1.04E-02 | 1.09E-02 | 1.01E-02 | 1.74E-05 | 7.06E-05 | 3.55E-05 | 1.44E-04 |
| 6 - 7 | 8.47E-03 | 0. | 8.86E-03 | 8.77E-03 | 8.17E-03 | 8.45E-03 | 7.92E-03 | 1.29E-05 | 4.88E-05 | 2.90E-05 | 1.18E-04 |
| 7 - 8 | 6.66E-03 | 0. | 6.99E-03 | 6.85E-03 | 6.37E-03 | 6.64E-03 | 6.15E-03 | 7.61E-06 | 3.08E-05 | 1.94E-05 | 7.88E-05 |
| 8 - 9 | 5.17E-03 | 0. | 5.54E-03 | 5.38E-03 | 4.95E-03 | 5.17E-03 | 4.70E-03 | 6.73E-05 | 5.37E-06 | 1.04E-05 | 6.62E-05 |
| 9 - 10 | 3.98E-03 | 0. | 4.25E-03 | 4.21E-03 | 3.80E-03 | 4.00E-03 | 3.50E-03 | 5.01E-05 | 4.00E-06 | 7.61E-06 | 4.84E-05 |
| 10 - 11 | 3.05E-03 | 0. | 3.36E-03 | 3.24E-03 | 2.87E-03 | 3.05E-03 | 2.58E-03 | 4.27E-05 | 3.41E-06 | 8.22E-06 | 5.23E-05 |
| 11 - 12 | 2.28E-03 | 0. | 2.55E-03 | 2.51E-03 | 2.13E-03 | 2.25E-03 | 1.90E-03 | 3.92E-05 | 3.13E-06 | 9.46E-06 | 6.02E-05 |
| 12 - 13 | 1.68E-03 | 0. | 2.01E-03 | 1.92E-03 | 1.57E-03 | 1.68E-03 | 1.39E-03 | 3.66E-05 | 2.92E-06 | 1.09E-05 | 6.93E-05 |
| 13 - 14 | 1.23E-03 | 0. | 1.46E-03 | 1.43E-03 | 1.15E-03 | 1.25E-03 | 1.02E-03 | 3.61E-05 | 2.88E-06 | 1.18E-05 | 7.52E-05 |
| 14 - 15 | 9.02E-04 | 0. | 1.15E-03 | 1.08E-03 | 8.52E-04 | 9.44E-04 | 7.51E-04 | 3.67E-05 | 2.93E-06 | 1.21E-05 | 7.68E-05 |
| 15 - 16 | 6.60E-04 | 0. | 8.55E-04 | 7.64E-04 | 6.24E-04 | 6.94E-04 | 5.47E-04 | 3.65E-05 | 2.92E-06 | 1.18E-05 | 7.48E-05 |
| 16 - 17 | 4.82E-04 | 0. | 5.95E-04 | 5.51E-04 | 4.57E-04 | 5.08E-04 | 4.02E-04 | 3.53E-05 | 2.82E-06 | 1.08E-05 | 6.87E-05 |
| 17 - 18 | 3.54E-04 | 0. | 4.50E-04 | 4.07E-04 | 3.37E-04 | 3.74E-04 | 2.99E-04 | 3.31E-05 | 2.64E-06 | 9.46E-06 | 6.01E-05 |
| 18 - 19 | 2.59E-04 | 0. | 3.02E-04 | 2.96E-04 | 2.45E-04 | 2.78E-04 | 2.16E-04 | 3.00E-05 | 2.39E-06 | 7.89E-06 | 5.02E-05 |
| 19 - 20 | 1.89E-04 | 0. | 2.10E-04 | 2.17E-04 | 1.79E-04 | 2.07E-04 | 1.54E-04 | 2.60E-05 | 2.09E-06 | 6.33E-06 | 4.03E-05 |
| 20 - 21 | 1.38E-04 | 0. | 1.50E-04 | 1.58E-04 | 1.32E-04 | 1.50E-04 | 1.15E-04 | 2.20E-05 | 1.76E-06 | 5.05E-06 | 3.21E-05 |
| 21 - 22 | 1.01E-04 | 0. | 1.06E-04 | 1.15E-04 | 9.58E-05 | 1.12E-04 | 8.41E-05 | 1.84E-05 | 1.47E-06 | 4.04E-06 | 2.57E-05 |
| 22 - 23 | 7.33E-05 | 0. | 7.54E-05 | 8.33E-05 | 6.96E-05 | 8.28E-05 | 6.13E-05 | 1.53E-05 | 1.22E-06 | 3.14E-06 | 2.00E-05 |
| 23 - 24 | 5.36E-05 | 0. | 5.47E-05 | 6.33E-05 | 5.02E-05 | 6.11E-05 | 4.47E-05 | 1.22E-05 | 0. | 2.43E-06 | 1.55E-05 |
| 24 - 25 | 3.93E-05 | 0. | 4.03E-05 | 4.52E-05 | 3.94E-05 | 4.50E-05 | 3.26E-05 | 9.63E-06 | 0. | 1.92E-06 | 1.22E-05 |
| 25 - 30 | 1.70E-05 | 0. | 1.72E-05 | 1.93E-05 | 1.58E-05 | 1.98E-05 | 1.37E-05 | 1.13E-05 | 1.37E-05 | 2.88E-05 | 3.51E-05 |
| 30 - 35 | 3.69E-06 | 0. | 3.75E-06 | 4.37E-06 | 3.24E-06 | 4.50E-06 | 2.76E-06 | 3.47E-06 | 4.23E-06 | 6.62E-06 | 8.05E-06 |
| 35 - 40 | 0. | 0. | 0. | 1.03E-06 | 0. | 1.05E-06 | 0. | 1.71E-06 | 2.08E-06 | 2.14E-06 | 2.61E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.02E-06 | 0. | 1.02E-06 |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | CLEAR $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.98E-02 | 5.37E-02 |
| MARITIME | 1.09E-03 | 3.79E-02 | 1.41E-02 | 4.13E-01 |
| TROPOSPHERIC | 2.91E-04 | 1.18E-03 | ******** | ******** |

WAVELENGTH = 3.927159 MICROMETERS
FREQUENCY = 2546.370 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4.32E-02 | 0. | 6.11E-02 | 5.50E-02 | 4.35E-02 | 4.89E-02 | 4.20E-02 | 9.97E-04 | 6.33E-03 | 1.09E-02 | 6.98E-02 |
| 0 - 1 | 3.86E-02 | 0. | 5.25E-02 | 4.71E-02 | 3.83E-02 | 4.25E-02 | 3.66E-02 | 6.60E-04 | 4.19E-03 | 1.09E-02 | 6.98E-02 |
| 1 - 2 | 3.16E-02 | 0. | 4.03E-02 | 3.57E-02 | 3.12E-02 | 3.37E-02 | 3.02E-02 | 7.42E-05 | 2.96E-04 | 1.18E-03 | 4.56E-03 |
| 2 - 3 | 2.57E-02 | 0. | 2.99E-02 | 2.77E-02 | 2.52E-02 | 2.69E-02 | 2.46E-02 | 3.79E-05 | 1.46E-04 | 2.00E-04 | 7.71E-04 |
| 3 - 4 | 2.07E-02 | 0. | 2.21E-02 | 2.13E-02 | 2.03E-02 | 2.15E-02 | 1.99E-02 | 3.09E-05 | 1.19E-04 | 1.09E-04 | 4.22E-04 |
| 4 - 5 | 1.67E-02 | 0. | 1.73E-02 | 1.69E-02 | 1.64E-02 | 1.70E-02 | 1.61E-02 | 2.38E-05 | 9.19E-05 | 5.69E-05 | 2.19E-04 |
| 5 - 6 | 1.35E-02 | 0. | 1.40E-02 | 1.36E-02 | 1.32E-02 | 1.36E-02 | 1.29E-02 | 1.77E-05 | 6.82E-05 | 3.60E-05 | 1.39E-04 |
| 6 - 7 | 1.08E-02 | 0. | 1.11E-02 | 1.11E-02 | 1.05E-02 | 1.07E-02 | 1.03E-02 | 1.22E-05 | 4.72E-05 | 2.49E-05 | 1.14E-04 |
| 7 - 8 | 8.61E-03 | 0. | 8.91E-03 | 8.76E-03 | 8.31E-03 | 8.57E-03 | 8.11E-03 | 7.73E-06 | 2.98E-05 | 1.97E-05 | 7.62E-05 |
| 8 - 9 | 6.79E-03 | 0. | 7.19E-03 | 6.96E-03 | 6.55E-03 | 6.79E-03 | 6.30E-03 | 6.58E-06 | 5.12E-06 | 9.71E-06 | 6.36E-05 |
| 9 - 10 | 5.33E-03 | 0. | 5.61E-03 | 5.56E-03 | 5.12E-03 | 5.35E-03 | 4.75E-03 | 4.90E-06 | 3.81E-06 | 7.09E-06 | 4.65E-05 |
| 10 - 11 | 4.16E-03 | 0. | 4.51E-03 | 4.35E-03 | 3.93E-03 | 4.14E-03 | 3.55E-03 | 4.17E-06 | 3.25E-06 | 7.66E-06 | 5.02E-05 |
| 11 - 12 | 3.15E-03 | 0. | 3.48E-03 | 3.44E-03 | 2.95E-03 | 3.11E-03 | 2.66E-03 | 3.83E-06 | 2.98E-06 | 8.82E-06 | 5.78E-05 |
| 12 - 13 | 2.36E-03 | 0. | 2.80E-03 | 2.67E-03 | 2.21E-03 | 2.34E-03 | 1.97E-03 | 3.57E-06 | 2.78E-06 | 1.02E-05 | 6.65E-05 |
| 13 - 14 | 1.75E-03 | 0. | 2.16E-03 | 2.03E-03 | 1.64E-03 | 1.77E-03 | 1.47E-03 | 3.53E-06 | 2.74E-06 | 1.10E-05 | 7.22E-05 |
| 14 - 15 | 1.30E-03 | 0. | 1.66E-03 | 1.55E-03 | 1.23E-03 | 1.36E-03 | 1.10E-03 | 3.58E-06 | 2.79E-06 | 1.13E-05 | 7.37E-05 |
| 15 - 16 | 9.69E-04 | 0. | 1.26E-03 | 1.11E-03 | 9.18E-04 | 9.62E-04 | 8.10E-04 | 3.57E-06 | 2.78E-06 | 1.10E-05 | 7.18E-05 |
| 16 - 17 | 7.18E-04 | 0. | 8.91E-04 | 8.16E-04 | 6.82E-04 | 7.55E-04 | 6.05E-04 | 3.46E-06 | 2.69E-06 | 1.01E-05 | 6.58E-05 |
| 17 - 18 | 5.35E-04 | 0. | 6.51E-04 | 6.12E-04 | 5.12E-04 | 5.66E-04 | 4.51E-04 | 3.24E-06 | 2.52E-06 | 8.82E-06 | 5.78E-05 |
| 18 - 19 | 3.98E-04 | 0. | 4.61E-04 | 4.52E-04 | 3.78E-04 | 4.28E-04 | 3.35E-04 | 2.93E-06 | 2.28E-06 | 7.36E-06 | 4.82E-05 |
| 19 - 20 | 2.96E-04 | 0. | 3.25E-04 | 3.31E-04 | 2.80E-04 | 3.26E-04 | 2.49E-04 | 2.54E-06 | 1.98E-06 | 5.90E-06 | 3.87E-05 |
| 20 - 21 | 2.20E-04 | 0. | 2.36E-04 | 2.50E-04 | 2.11E-04 | 2.42E-04 | 1.85E-04 | 2.15E-06 | 1.67E-06 | 4.71E-06 | 3.09E-05 |
| 21 - 22 | 1.64E-04 | 0. | 1.72E-04 | 1.88E-04 | 1.56E-04 | 1.85E-04 | 1.38E-04 | 1.80E-06 | 1.40E-06 | 3.77E-06 | 2.46E-05 |
| 22 - 23 | 1.23E-04 | 0. | 1.25E-04 | 1.39E-04 | 1.16E-04 | 1.40E-04 | 1.02E-04 | 1.49E-06 | 1.16E-06 | 2.99E-06 | 1.92E-05 |
| 23 - 24 | 9.18E-05 | 0. | 9.29E-05 | 1.03E-04 | 8.48E-05 | 1.06E-04 | 7.54E-05 | 1.20E-06 | 0. | 2.27E-06 | 1.43E-05 |
| 24 - 25 | 6.89E-05 | 0. | 7.02E-05 | 7.94E-05 | 6.60E-05 | 8.02E-05 | 5.56E-05 | 9.42E-06 | 0. | 1.79E-06 | 1.17E-05 |
| 25 - 30 | 3.15E-05 | 0. | 3.22E-05 | 3.76E-05 | 2.82E-05 | 3.81E-05 | 2.42E-05 | 1.13E-06 | 1.35E-05 | 2.90E-05 | 3.45E-05 |
| 30 - 35 | 9.79E-06 | 0. | 1.08E-05 | 1.26E-05 | 7.80E-06 | 9.35E-06 | 6.49E-06 | 3.49E-06 | 4.16E-06 | 6.65E-06 | 7.92E-06 |
| 35 - 40 | 3.68E-06 | 0. | 4.16E-06 | 4.97E-06 | 2.65E-06 | 5.35E-06 | 2.01E-06 | 1.72E-06 | 2.04E-06 | 2.16E-06 | 2.57E-06 |
| 40 - 45 | 1.84E-06 | 0. | 2.02E-06 | 2.48E-06 | 1.31E-06 | 2.77E-06 | 0. | 0. | 1.01E-06 | 0. | 1.01E-06 |
| 45 - 50 | 0. | 0. | 1.07E-06 | 1.37E-06 | 0. | 1.49E-06 | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.93E-02 | 5.32E-02 |
| MARITIME | 1.33E-03 | 3.74E-02 | 1.45E-02 | 4.08E-01 |
| TROPOSPHERIC | 2.95E-04 | 1.14E-03 | ******** | ******** |

WAVELENGTH = 4.005431 MICROMETERS
FREQUENCY = 2496.610 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3.91E-02 | 0. | 6.31E-02 | 5.46E-02 | 3.76E-02 | 4.61E-02 | 3.42E-02 | 1.02E-03 | 6.25E-03 | 1.12E-02 | 6.30E-02 |
| 0 - 1 | 3.34E-02 | 0. | 5.32E-02 | 4.55E-02 | 3.06E-02 | 3.83E-02 | 2.66E-02 | 6.78E-04 | 4.13E-03 | 1.12E-02 | 6.80E-02 |
| 1 - 2 | 2.52E-02 | 0. | 3.42E-02 | 3.18E-02 | 2.30E-02 | 2.80E-02 | 2.06E-02 | 7.63E-05 | 2.72E-04 | 1.22E-03 | 4.33E-03 |
| 2 - 3 | 1.87E-02 | 0. | 2.59E-02 | 2.23E-02 | 1.72E-02 | 2.05E-02 | 1.56E-02 | 3.90E-05 | 1.39E-04 | 2.06E-04 | 7.33E-04 |
| 3 - 4 | 1.38E-02 | 0. | 1.68E-02 | 1.55E-02 | 1.27E-02 | 1.50E-02 | 1.16E-02 | 2.18E-05 | 1.13E-04 | 1.12E-04 | 4.01E-04 |
| 4 - 5 | 1.01E-02 | 0. | 1.18E-02 | 1.11E-02 | 9.35E-03 | 1.08E-02 | 8.59E-03 | 2.45E-05 | 8.74E-05 | 5.85E-05 | 2.08E-04 |
| 5 - 6 | 7.48E-03 | 0. | 8.75E-03 | 8.14E-03 | 6.91E-03 | 7.90E-03 | 6.30E-03 | 1.82E-05 | 6.49E-05 | 3.71E-05 | 1.32E-04 |
| 6 - 7 | 5.52E-03 | 0. | 6.36E-03 | 6.13E-03 | 5.08E-03 | 5.67E-03 | 4.63E-03 | 1.26E-05 | 4.48E-05 | 3.03E-05 | 1.08E-04 |
| 7 - 8 | 4.08E-03 | 0. | 4.68E-03 | 4.50E-03 | 3.72E-03 | 4.15E-03 | 3.38E-03 | 7.95E-06 | 2.84E-05 | 2.03E-05 | 7.24E-05 |
| 8 - 9 | 2.98E-03 | 0. | 3.48E-03 | 3.33E-03 | 2.74E-03 | 3.02E-03 | 2.47E-03 | 6.36E-05 | 4.74E-06 | 8.74E-06 | 5.98E-05 |
| 9 - 10 | 2.17E-03 | 0. | 2.52E-03 | 2.48E-03 | 2.01E-03 | 2.20E-03 | 1.79E-03 | 4.73E-05 | 3.53E-06 | 6.38E-06 | 4.37E-05 |
| 10 - 11 | 1.58E-03 | 0. | 1.88E-03 | 1.81E-03 | 1.46E-03 | 1.62E-03 | 1.31E-03 | 4.03E-05 | 3.01E-06 | 6.89E-06 | 4.72E-05 |
| 11 - 12 | 1.15E-03 | 0. | 1.36E-03 | 1.33E-03 | 1.09E-03 | 1.19E-03 | 9.57E-04 | 3.70E-05 | 2.76E-06 | 7.93E-06 | 5.43E-05 |
| 12 - 13 | 8.39E-04 | 0. | 1.03E-03 | 9.74E-04 | 7.93E-04 | 8.75E-04 | 6.95E-04 | 3.46E-05 | 2.58E-06 | 9.14E-06 | 6.26E-05 |
| 13 - 14 | 6.12E-04 | 0. | 7.15E-04 | 7.11E-04 | 5.76E-04 | 6.50E-04 | 5.08E-04 | 3.41E-05 | 2.54E-06 | 9.92E-06 | 6.79E-05 |
| 14 - 15 | 4.47E-04 | 0. | 5.46E-04 | 5.36E-04 | 4.24E-04 | 4.87E-04 | 3.77E-04 | 3.46E-05 | 2.58E-06 | 1.01E-05 | 6.93E-05 |
| 15 - 16 | 3.26E-04 | 0. | 3.91E-04 | 3.77E-04 | 3.09E-04 | 3.39E-04 | 2.70E-04 | 3.45E-05 | 2.57E-06 | 9.86E-06 | 6.75E-05 |
| 16 - 17 | 2.38E-04 | 0. | 2.65E-04 | 2.71E-04 | 2.25E-04 | 2.61E-04 | 1.98E-04 | 3.34E-05 | 2.49E-06 | 9.06E-06 | 6.20E-05 |
| 17 - 18 | 1.74E-04 | 0. | 1.92E-04 | 2.00E-04 | 1.66E-04 | 1.92E-04 | 1.44E-04 | 3.13E-05 | 2.33E-06 | 7.93E-06 | 5.43E-05 |
| 18 - 19 | 1.27E-04 | 0. | 1.37E-04 | 1.45E-04 | 1.20E-04 | 1.42E-04 | 1.05E-04 | 2.83E-05 | 2.11E-06 | 6.62E-06 | 4.53E-05 |
| 19 - 20 | 9.29E-05 | 0. | 9.73E-05 | 1.07E-04 | 8.70E-05 | 1.06E-04 | 7.67E-05 | 2.46E-05 | 1.83E-06 | 5.31E-06 | 3.63E-05 |
| 20 - 21 | 6.79E-05 | 0. | 7.09E-05 | 7.82E-05 | 6.45E-05 | 7.70E-05 | 5.59E-05 | 2.08E-05 | 1.55E-06 | 4.24E-06 | 2.90E-05 |
| 21 - 22 | 4.98E-05 | 0. | 5.17E-05 | 5.73E-05 | 4.67E-05 | 5.74E-05 | 4.07E-05 | 1.74E-05 | 1.30E-06 | 3.38E-06 | 2.32E-05 |
| 22 - 23 | 3.65E-05 | 0. | 3.78E-05 | 4.18E-05 | 3.40E-05 | 4.25E-05 | 2.96E-05 | 1.44E-05 | 1.08E-06 | 2.63E-06 | 1.80E-05 |
| 23 - 24 | 2.68E-05 | 0. | 2.71E-05 | 3.20E-05 | 2.45E-05 | 3.14E-05 | 2.15E-05 | 1.16E-05 | 0. | 2.04E-06 | 1.39E-05 |
| 24 - 25 | 1.98E-05 | 0. | 2.02E-05 | 2.30E-05 | 1.88E-05 | 2.33E-05 | 1.57E-05 | 9.10E-06 | 0. | 1.61E-06 | 1.10E-05 |
| 25 - 30 | 8.69E-06 | 0. | 8.47E-06 | 1.04E-05 | 7.76E-06 | 1.05E-05 | 6.65E-06 | 1.14E-05 | 1.31E-05 | 2.92E-05 | 3.36E-05 |
| 30 - 35 | 1.95E-06 | 0. | 2.05E-06 | 2.41E-06 | 1.64E-06 | 2.50E-06 | 1.38E-06 | 7.52E-06 | 4.06E-06 | 6.70E-06 | 7.72E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.73E-06 | 1.99E-06 | 2.17E-06 | 2.50E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.96E-02 | 5.25E-02 |
| MARITIME | 1.40E-03 | 3.67E-02 | 1.52E-02 | 4.80E-01 |
| TROPOSPHERIC | 3.04E-04 | 1.08E-03 | ******** | ******** |

WAVELENGTH = 4.259677 MICROMETERS
FREQUENCY = 2463.250 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 6.95E-02 | 0. | 1.08E-01 | 9.37E-02 | 6.70E-02 | 7.93E-02 | 6.24E-02 | 1.09E-03 | 6.16E-03 | 1.13E-02 | 6.71E-02 |
| 0 - 1 | 5.95E-02 | 0. | 9.12E-02 | 7.86E-02 | 5.47E-02 | 6.67E-02 | 4.95E-02 | 7.20E-04 | 4.04E-03 | 1.13E-02 | 6.71E-02 |
| 1 - 2 | 4.51E-02 | 0. | 6.58E-02 | 5.57E-02 | 4.15E-02 | 4.93E-02 | 3.77E-02 | 8.13E-05 | 2.63E-04 | 1.30E-03 | 4.20E-03 |
| 2 - 3 | 3.39E-02 | 0. | 4.64E-02 | 3.98E-02 | 3.14E-02 | 3.65E-02 | 2.88E-02 | 4.13E-05 | 1.35E-04 | 2.21E-04 | 7.11E-04 |
| 3 - 4 | 2.53E-02 | 0. | 3.07E-02 | 2.82E-02 | 2.35E-02 | 2.71E-02 | 2.17E-02 | 3.41E-05 | 1.10E-04 | 1.21E-04 | 3.88E-04 |
| 4 - 5 | 1.89E-02 | 0. | 2.18E-02 | 2.08E-02 | 1.76E-02 | 1.99E-02 | 1.63E-02 | 2.63E-05 | 8.46E-05 | 6.23E-05 | 2.02E-04 |
| 5 - 6 | 1.42E-02 | 0. | 1.66E-02 | 1.54E-02 | 1.33E-02 | 1.49E-02 | 1.22E-02 | 1.95E-05 | 6.28E-05 | 3.98E-05 | 1.29E-04 |
| 6 - 7 | 1.07E-02 | 0. | 1.22E-02 | 1.18E-02 | 9.92E-03 | 1.09E-02 | 9.09E-03 | 1.39E-05 | 4.34E-05 | 3.26E-05 | 1.05E-04 |
| 7 - 8 | 8.07E-03 | 0. | 9.14E-03 | 8.84E-03 | 7.43E-03 | 8.16E-03 | 6.75E-03 | 9.54E-06 | 2.75E-05 | 2.16E-05 | 7.11E-05 |
| 8 - 9 | 5.99E-03 | 0. | 6.86E-03 | 6.66E-03 | 5.57E-03 | 6.07E-03 | 5.01E-03 | 6.24E-05 | 4.51E-06 | 8.65E-06 | 5.74E-05 |
| 9 - 10 | 4.46E-03 | 0. | 5.16E-03 | 5.06E-03 | 4.16E-03 | 4.53E-03 | 3.72E-03 | 4.64E-05 | 3.36E-06 | 6.31E-06 | 4.23E-05 |
| 10 - 11 | 3.32E-03 | 0. | 3.94E-03 | 3.78E-03 | 3.12E-03 | 3.42E-03 | 2.73E-03 | 2.96E-05 | 2.86E-06 | 6.82E-06 | 4.57E-05 |
| 11 - 12 | 2.47E-03 | 0. | 2.91E-03 | 2.85E-03 | 2.35E-03 | 2.57E-03 | 2.09E-03 | 1.63E-05 | 2.43E-06 | 7.85E-06 | 5.26E-05 |
| 12 - 13 | 1.85E-03 | 0. | 2.25E-03 | 2.13E-03 | 1.76E-03 | 1.94E-03 | 1.56E-03 | 7.39E-06 | 2.46E-06 | 9.04E-06 | 6.06E-05 |
| 13 - 14 | 1.39E-03 | 0. | 1.59E-03 | 1.59E-03 | 1.31E-03 | 1.49E-03 | 1.17E-03 | 7.34E-06 | 2.42E-06 | 9.82E-06 | 6.58E-05 |
| 14 - 15 | 1.04E-03 | 0. | 1.23E-03 | 1.23E-03 | 9.91E-04 | 1.15E-03 | 8.81E-04 | 7.40E-06 | 2.46E-06 | 1.01E-05 | 6.73E-05 |
| 15 - 16 | 7.78E-04 | 0. | 8.91E-04 | 8.98E-04 | 7.40E-04 | 8.18E-04 | 6.54E-04 | 3.39E-05 | 2.45E-06 | 9.76E-06 | 6.54E-05 |
| 16 - 17 | 5.80E-04 | 0. | 6.13E-04 | 6.55E-04 | 5.51E-04 | 6.45E-04 | 4.88E-04 | 8.26E-05 | 2.37E-06 | 8.95E-06 | 6.01E-05 |
| 17 - 18 | 4.33E-04 | 0. | 4.65E-04 | 4.93E-04 | 4.13E-04 | 4.84E-04 | 3.63E-04 | 3.07E-05 | 2.22E-06 | 7.85E-06 | 5.26E-05 |
| 18 - 19 | 3.22E-04 | 0. | 3.34E-04 | 3.65E-04 | 3.03E-04 | 3.65E-04 | 2.68E-04 | 2.78E-05 | 2.01E-06 | 6.55E-06 | 4.39E-05 |
| 19 - 20 | 2.38E-04 | 0. | 2.42E-04 | 2.73E-04 | 2.23E-04 | 2.75E-04 | 1.97E-04 | 2.41E-05 | 1.74E-06 | 5.25E-06 | 3.52E-05 |
| 20 - 21 | 1.76E-04 | 0. | 1.80E-04 | 2.03E-04 | 1.67E-04 | 2.02E-04 | 1.45E-04 | 2.04E-05 | 1.47E-06 | 4.13E-06 | 2.81E-05 |
| 21 - 22 | 1.31E-04 | 0. | 1.33E-04 | 1.52E-04 | 1.22E-04 | 1.52E-04 | 1.06E-04 | 1.71E-05 | 1.23E-06 | 3.35E-06 | 2.24E-05 |
| 22 - 23 | 9.64E-05 | 0. | 9.82E-05 | 1.11E-04 | 8.91E-05 | 1.13E-04 | 7.73E-05 | 1.41E-05 | 1.02E-06 | 2.61E-06 | 1.75E-05 |
| 23 - 24 | 7.13E-05 | 0. | 7.17E-05 | 8.54E-05 | 6.45E-05 | 8.43E-05 | 5.64E-05 | 1.13E-05 | 0. | 2.02E-06 | 1.35E-05 |
| 24 - 25 | 5.29E-05 | 0. | 5.38E-05 | 6.18E-05 | 4.96E-05 | 6.30E-05 | 4.10E-05 | 8.93E-06 | 0. | 1.59E-06 | 1.06E-05 |
| 25 - 30 | 2.35E-05 | 0. | 2.41E-05 | 2.84E-05 | 2.07E-05 | 2.88E-05 | 1.76E-05 | 1.14E-05 | 1.30E-05 | 2.92E-05 | 3.32E-05 |
| 30 - 35 | 5.50E-06 | 0. | 5.23E-06 | 6.47E-06 | 4.54E-06 | 7.01E-06 | 3.77E-06 | 3.51E-06 | 4.00E-06 | 6.69E-06 | 7.62E-06 |
| 35 - 40 | 1.36E-06 | 0. | 1.48E-06 | 1.76E-06 | 1.05E-06 | 1.83E-06 | 0. | 1.73E-06 | 1.97E-06 | 2.17E-06 | 2.47E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.73E-02 | 5.19E-02 |
| MARITIME | 1.59E-03 | 3.61E-02 | 1.73E-02 | 3.93E-01 |
| TROPOSPHERIC | 3.95E-04 | 1.15E-01 | ******** | ******** |

WAVELENGTH = 4.141975 MICROMETERS
FREQUENCY = 2414.690 WAVENUMBER

| h(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.01E-01 | 0. | 1.28E-01 | 1.13E-01 | 1.04E-01 | 1.10E-01 | 1.02E-01 | 1.16E-03 | 6.04E-03 | 1.28E-02 | 6.58E-02 |
| 0 - 1 | 8.71E-02 | 0. | 1.11E-01 | 1.02E-01 | 8.41E-02 | 9.31E-02 | 7.81E-02 | 7.80E-04 | 4.03E-03 | 1.28E-02 | 6.58E-02 |
| 1 - 2 | 6.71E-02 | 0. | 8.30E-02 | 7.51E-02 | 6.42E-02 | 7.05E-02 | 6.02E-02 | 9.00E-05 | 2.51E-04 | 1.43E-03 | 4.01E-03 |
| 2 - 3 | 5.12E-02 | 0. | 6.05E-02 | 5.67E-02 | 4.89E-02 | 5.34E-02 | 4.59E-02 | 4.60E-05 | 1.28E-04 | 2.43E-04 | 6.77E-04 |
| 3 - 4 | 3.88E-02 | 0. | 4.34E-02 | 4.14E-02 | 3.69E-02 | 4.04E-02 | 3.46E-02 | 2.75E-05 | 1.05E-04 | 1.35E-04 | 3.70E-04 |
| 4 - 5 | 2.94E-02 | 0. | 3.23E-02 | 3.10E-02 | 2.78E-02 | 3.02E-02 | 2.60E-02 | 2.89E-05 | 8.07E-05 | 5.90E-05 | 1.93E-04 |
| 5 - 6 | 2.21E-02 | 0. | 2.40E-02 | 2.36E-02 | 2.09E-02 | 2.28E-02 | 1.93E-02 | 2.15E-05 | 5.93E-05 | 4.37E-05 | 1.22E-04 |
| 6 - 7 | 1.66E-02 | 0. | 1.85E-02 | 1.81E-02 | 1.55E-02 | 1.69E-02 | 1.43E-02 | 1.48E-05 | 4.14E-05 | 3.58E-05 | 9.99E-05 |
| 7 - 8 | 1.24E-02 | 0. | 1.39E-02 | 1.35E-02 | 1.15E-02 | 1.26E-02 | 1.05E-02 | 9.38E-06 | 2.62E-05 | 2.40E-05 | 6.69E-05 |
| 8 - 9 | 9.17E-03 | 0. | 1.06E-02 | 1.01E-02 | 8.57E-03 | 9.30E-03 | 7.77E-03 | 6.06E-05 | 4.18E-06 | 8.51E-06 | 5.52E-05 |
| 9 - 10 | 6.76E-03 | 0. | 7.77E-03 | 7.51E-03 | 6.31E-03 | 6.87E-03 | 5.62E-03 | 4.51E-05 | 3.11E-06 | 6.22E-05 | 4.03E-05 |
| 10 - 11 | 4.95E-03 | 0. | 5.88E-03 | 5.51E-03 | 4.64E-03 | 5.04E-03 | 4.10E-03 | 3.84E-05 | 2.65E-06 | 6.72E-06 | 4.36E-05 |
| 11 - 12 | 3.62E-03 | 0. | 4.28E-03 | 4.18E-03 | 3.41E-03 | 3.74E-03 | 3.01E-03 | 3.53E-05 | 2.43E-06 | 7.73E-06 | 5.02E-05 |
| 12 - 13 | 2.64E-03 | 0. | 3.24E-03 | 3.06E-03 | 2.49E-03 | 2.76E-03 | 2.19E-03 | 3.29E-05 | 2.27E-06 | 8.91E-06 | 5.76E-05 |
| 13 - 14 | 1.93E-03 | 0. | 2.25E-03 | 2.24E-03 | 1.82E-03 | 2.05E-03 | 1.60E-03 | 3.25E-05 | 2.24E-06 | 9.67E-06 | 6.27E-05 |
| 14 - 15 | 1.41E-03 | 0. | 1.72E-03 | 1.69E-03 | 1.34E-03 | 1.54E-03 | 1.18E-03 | 3.30E-05 | 2.28E-06 | 9.87E-06 | 6.40E-05 |
| 15 - 16 | 1.03E-03 | 0. | 1.23E-03 | 1.19E-03 | 9.77E-04 | 1.09E-03 | 8.56E-04 | 3.29E-05 | 2.27E-06 | 9.61E-06 | 6.24E-05 |
| 16 - 17 | 7.53E-04 | 0. | 8.32E-04 | 8.58E-04 | 7.13E-04 | 8.32E-04 | 6.28E-04 | 3.18E-05 | 2.20E-06 | 8.83E-06 | 5.73E-05 |
| 17 - 18 | 5.54E-04 | 0. | 6.05E-04 | 6.35E-04 | 5.26E-04 | 6.14E-04 | 4.60E-04 | 2.98E-05 | 2.06E-06 | 7.73E-06 | 5.02E-05 |
| 18 - 19 | 4.06E-04 | 0. | 4.34E-04 | 4.64E-04 | 3.83E-04 | 4.57E-04 | 3.37E-04 | 2.70E-05 | 1.86E-06 | 6.45E-06 | 4.18E-05 |
| 19 - 20 | 2.99E-04 | 0. | 3.09E-04 | 3.43E-04 | 2.80E-04 | 3.43E-04 | 2.47E-04 | 2.34E-05 | 1.61E-06 | 5.17E-06 | 3.36E-05 |
| 20 - 21 | 2.20E-04 | 0. | 2.27E-04 | 2.53E-04 | 2.09E-04 | 2.52E-04 | 1.82E-04 | 1.98E-05 | 1.37E-06 | 4.13E-06 | 2.68E-05 |
| 21 - 22 | 1.64E-04 | 0. | 1.67E-04 | 1.90E-04 | 1.53E-04 | 1.90E-04 | 1.34E-04 | 1.66E-05 | 1.14E-06 | 3.30E-06 | 2.14E-05 |
| 22 - 23 | 1.22E-04 | 0. | 1.23E-04 | 1.39E-04 | 1.13E-04 | 1.43E-04 | 9.86E-05 | 1.37E-05 | 0. | 2.57E-06 | 1.67E-05 |
| 23 - 24 | 9.22E-05 | 0. | 9.23E-05 | 1.09E-04 | 8.33E-05 | 1.09E-04 | 7.32E-05 | 1.10E-05 | 0. | 1.99E-06 | 1.29E-05 |
| 24 - 25 | 7.03E-05 | 0. | 7.13E-05 | 8.14E-05 | 6.55E-05 | 8.35E-05 | 5.46E-05 | 8.67E-06 | 0. | 1.56E-06 | 1.02E-05 |
| 25 - 30 | 3.62E-05 | 0. | 3.76E-05 | 4.34E-05 | 3.09E-05 | 4.47E-05 | 2.67E-05 | 1.14E-05 | 1.27E-05 | 2.91E-05 | 3.25E-05 |
| 30 - 35 | 1.07E-05 | 0. | 1.20E-05 | 1.38E-05 | 8.32E-06 | 2.41E-05 | 6.93E-06 | 3.51E-06 | 3.92E-06 | 6.65E-06 | 7.47E-06 |
| 35 - 40 | 5.27E-06 | 0. | 5.92E-06 | 6.95E-06 | 3.77E-06 | 7.50E-06 | 2.86E-06 | 1.73E-06 | 1.93E-06 | 2.17E-06 | 2.42E-06 |
| 40 - 45 | 3.31E-06 | 0. | 3.58E-06 | 4.31E-06 | 2.41E-06 | 4.79E-06 | 1.66E-06 | 0. | 0. | 0. | 0. |
| 45 - 50 | 2.02E-06 | 0. | 2.15E-06 | 2.69E-06 | 1.55E-06 | 2.90E-06 | 1.08E-06 | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0 | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.80E-02 | 5.09E-02 |
| MARITIME | 1.86E-03 | 3.51E-02 | 2.03E-02 | 3.83E-01 |
| TROPOSPHERIC | 3.58E-04 | 1.00E-03 | ******** | ******** |

WAVELENGTH = 4.591339 MICROMETERS
FREQUENCY = 2177.990 WAVENUMBER

| h(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 7.73E-02 | 0. | 8.74E-02 | 8.03E-02 | 5.68E-02 | 7.44E-02 | 5.39E-02 | 1.52E-03 | 5.52E-03 | 1.65E-02 | 6.31E-02 |
| 0 - 1 | 6.36E-02 | 0. | 7.47E-02 | 6.07E-02 | 5.70E-02 | 6.41E-02 | 5.07E-02 | 1.00E-03 | 3.65E-03 | 1.65E-02 | 6.31E-02 |
| 1 - 2 | 4.87E-02 | 0. | 5.66E-02 | 5.39E-02 | 4.41E-02 | 4.92E-02 | 4.00E-02 | 1.20E-04 | 1.91E-04 | 1.99E-03 | 3.05E-03 |
| 2 - 3 | 3.70E-02 | 0. | 4.32E-02 | 4.14E-02 | 3.40E-02 | 3.75E-02 | 3.06E-02 | 5.12E-05 | 9.79E-05 | 3.22E-04 | 5.16E-04 |
| 3 - 4 | 2.78E-02 | 0. | 3.28E-02 | 3.09E-02 | 2.57E-02 | 2.87E-02 | 2.30E-02 | 4.99E-05 | 7.99E-05 | 1.76E-04 | 3.82E-04 |
| 4 - 5 | 2.07E-02 | 0. | 2.45E-02 | 2.33E-02 | 1.91E-02 | 2.14E-02 | 1.69E-02 | 7.84E-05 | 6.15E-05 | 9.17E-05 | 1.47E-04 |
| 5 - 6 | 1.52E-02 | 0. | 1.84E-02 | 1.76E-02 | 1.40E-02 | 1.59E-02 | 1.22E-02 | 2.85E-05 | 4.57E-05 | 5.81E-05 | 9.31E-05 |
| 6 - 7 | 1.11E-02 | 0. | 1.36E-02 | 1.32E-02 | 1.02E-02 | 1.14E-02 | 8.65E-03 | 1.97E-05 | 3.16E-05 | 4.79E-05 | 7.61E-05 |
| 7 - 8 | 8.23E-03 | 0. | 9.93E-03 | 9.55E-03 | 7.31E-03 | 8.23E-03 | 6.09E-03 | 1.25E-05 | 2.00E-05 | 3.18E-05 | 5.10E-05 |
| 8 - 9 | 5.73E-03 | 0. | 7.32E-03 | 6.85E-03 | 5.20E-03 | 5.91E-03 | 4.30E-03 | 5.25E-06 | 2.63E-06 | 8.07E-06 | 4.16E-05 |
| 9 - 10 | 4.01E-03 | 0. | 5.18E-03 | 4.87E-03 | 3.65E-03 | 4.17E-03 | 3.10E-03 | 3.91E-06 | 1.96E-06 | 5.90E-06 | 3.04E-05 |
| 10 - 11 | 2.79E-03 | 0. | 3.73E-03 | 3.51E-03 | 2.62E-03 | 3.01E-03 | 2.27E-03 | 2.33E-06 | 1.67E-06 | 3.37E-06 | 2.24E-05 |
| 11 - 12 | 1.99E-03 | 0. | 2.59E-03 | 2.49E-03 | 1.92E-03 | 2.23E-03 | 1.67E-03 | 1.06E-06 | 1.53E-06 | 1.33E-06 | 1.73E-05 |
| 12 - 13 | 1.46E-03 | 0. | 1.86E-03 | 1.73E-03 | 1.40E-03 | 1.65E-03 | 1.22E-03 | 2.85E-05 | 1.43E-06 | 8.44E-06 | 4.35E-05 |
| 13 - 14 | 1.07E-03 | 0. | 1.21E-03 | 1.23E-03 | 1.02E-03 | 1.23E-03 | 8.95E-04 | 2.82E-05 | 1.41E-06 | 9.17E-06 | 4.73E-05 |
| 14 - 15 | 7.84E-04 | 0. | 8.69E-04 | 9.33E-04 | 7.50E-04 | 9.29E-04 | 6.58E-04 | 2.86E-05 | 1.43E-06 | 9.36E-06 | 4.83E-05 |
| 15 - 16 | 5.74E-04 | 0. | 5.94E-04 | 6.53E-04 | 5.45E-04 | 6.49E-04 | 4.78E-04 | 2.85E-05 | 1.43E-06 | 9.11E-06 | 4.70E-05 |
| 16 - 17 | 4.19E-04 | 0. | 3.80E-04 | 4.75E-04 | 3.96E-04 | 5.01E-04 | 3.49E-04 | 2.76E-05 | 1.38E-06 | 8.37E-06 | 4.32E-05 |
| 17 - 18 | 3.08E-04 | 0. | 2.78E-04 | 3.51E-04 | 2.91E-04 | 3.69E-04 | 2.53E-04 | 2.59E-05 | 1.30E-06 | 7.33E-06 | 3.78E-05 |
| 18 - 19 | 2.26E-04 | 0. | 2.03E-04 | 2.57E-04 | 2.10E-04 | 2.74E-04 | 1.84E-04 | 2.34E-05 | 1.17E-06 | 6.12E-06 | 3.15E-05 |
| 19 - 20 | 1.65E-04 | 0. | 1.53E-04 | 1.91E-04 | 1.52E-04 | 2.05E-04 | 1.33E-04 | 2.03E-05 | 1.02E-06 | 4.91E-06 | 2.53E-05 |
| 20 - 21 | 1.21E-04 | 0. | 1.16E-04 | 1.42E-04 | 1.13E-04 | 1.49E-04 | 9.66E-05 | 1.72E-05 | 0. | 3.92E-06 | 2.02E-05 |
| 21 - 22 | 9.00E-05 | 0. | 8.80E-05 | 1.06E-04 | 8.19E-05 | 1.11E-04 | 6.99E-05 | 1.44E-05 | 0. | 3.13E-06 | 1.61E-05 |
| 22 - 23 | 6.66E-05 | 0. | 6.63E-05 | 7.73E-05 | 5.96E-05 | 8.23E-05 | 5.05E-05 | 1.19E-05 | 0. | 2.43E-06 | 1.26E-05 |
| 23 - 24 | 4.95E-05 | 0. | 4.83E-05 | 6.06E-05 | 4.30E-05 | 6.13E-05 | 3.65E-05 | 9.55E-06 | 0. | 1.88E-06 | 9.71E-06 |
| 24 - 25 | 3.69E-05 | 0. | 3.71E-05 | 4.40E-05 | 3.29E-05 | 4.61E-05 | 2.63E-05 | 7.52E-06 | 0. | 1.48E-06 | 7.65E-06 |
| 25 - 30 | 1.67E-05 | 0. | 1.75E-05 | 2.10E-05 | 1.37E-05 | 2.13E-05 | 1.14E-05 | 1.12E-05 | 1.15E-05 | 2.86E-05 | 2.94E-05 |
| 30 - 35 | 4.87E-06 | 0. | 4.84E-06 | 5.48E-06 | 3.12E-06 | 5.72E-06 | 2.52E-06 | 3.45E-06 | 3.54E-06 | 6.57E-06 | 6.75E-06 |
| 35 - 40 | 1.11E-06 | 0. | 1.25E-06 | 1.54E-06 | 0. | 1.64E-06 | 0. | 1.70E-06 | 1.74E-06 | 2.13E-06 | 2.19E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.56E-02 | 4.66E-02 |
| MARITIME | 2.87E-03 | 3.08E-02 | 3.13E-02 | 3.35E-01 |
| TROPOSPHERIC | 4.76E-04 | 7.63E-04 | ******** | ******** |

WAVELENGTH = 4.759027 MICROMETERS
FREQUENCY = 2101.270 WAVENUMBER

| h1(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | CLEAR $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5.84E-02 | 0. | 1.72E-01 | 1.23E-01 | 3.81E-02 | 8.04E-02 | 2.25E-02 | 1.47E-03 | 5.44E-03 | 1.63E-02 | 5.92E-02 |
| 0 - 1 | 4.89E-02 | 0. | 1.34E-01 | 9.69E-02 | 3.31E-02 | 6.42E-02 | 2.18E-02 | 9.74E-04 | 3.60E-03 | 1.60E-02 | 5.92E-02 |
| 1 - 2 | 3.48E-02 | 0. | 9.45E-02 | 6.82E-02 | 2.58E-02 | 4.31E-02 | 1.98E-02 | 1.15E-04 | 1.73E-04 | 1.83E-03 | 2.75E-03 |
| 2 - 3 | 2.55E-02 | 0. | 5.05E-02 | 3.79E-02 | 2.03E-02 | 3.05E-02 | 1.73E-02 | 5.68E-05 | 8.94E-05 | 3.13E-04 | 4.66E-04 |
| 3 - 4 | 1.95E-02 | 0. | 2.92E-02 | 2.53E-02 | 1.71E-02 | 2.28E-02 | 1.51E-02 | 4.79E-05 | 7.20E-05 | 1.63E-04 | 2.55E-04 |
| 4 - 5 | 1.59E-02 | 0. | 2.05E-02 | 1.85E-02 | 1.46E-02 | 1.78E-02 | 1.33E-02 | 3.69E-05 | 5.55E-05 | 8.81E-05 | 1.32E-04 |
| 5 - 6 | 1.35E-02 | 0. | 1.64E-02 | 1.54E-02 | 1.29E-02 | 1.48E-02 | 1.17E-02 | 2.74E-05 | 4.12E-05 | 5.58E-05 | 8.41E-05 |
| 6 - 7 | 1.18E-02 | 0. | 1.34E-02 | 1.35E-02 | 1.15E-02 | 1.25E-02 | 1.05E-02 | 1.48E-05 | 2.23E-05 | 4.57E-05 | 6.87E-05 |
| 7 - 8 | 1.04E-02 | 0. | 1.14E-02 | 1.17E-02 | 1.03E-02 | 1.13E-02 | 9.55E-03 | 1.20E-05 | 1.80E-05 | 3.06E-05 | 4.61E-05 |
| 8 - 9 | 9.16E-03 | 0. | 1.00E-02 | 1.03E-02 | 9.39E-03 | 9.73E-03 | 8.92E-03 | 5.84E-06 | 2.24E-06 | 8.21E-06 | 3.67E-05 |
| 9 - 10 | 8.15E-03 | 0. | 9.57E-03 | 9.06E-03 | 8.54E-03 | 8.77E-03 | 8.70E-03 | 7.73E-06 | 1.66E-06 | 6.00E-06 | 2.64E-05 |
| 10 - 11 | 7.32E-03 | 0. | 7.53E-03 | 7.94E-03 | 7.93E-03 | 8.06E-03 | 8.46E-03 | 7.23E-06 | 1.42E-06 | 6.49E-06 | 2.83E-05 |
| 11 - 12 | 6.57E-03 | 0. | 6.37E-03 | 7.03E-03 | 7.41E-03 | 7.47E-03 | 8.25E-03 | 2.97E-05 | 1.30E-06 | 7.46E-06 | 3.23E-05 |
| 12 - 13 | 5.98E-03 | 0. | 5.58E-03 | 6.16E-03 | 6.83E-03 | 6.83E-03 | 7.77E-03 | 2.77E-05 | 1.22E-06 | 8.59E-06 | 3.64E-05 |
| 13 - 14 | 5.32E-03 | 0. | 4.45E-03 | 5.54E-03 | 6.15E-03 | 6.34E-03 | 6.97E-03 | 2.73E-05 | 1.20E-06 | 9.33E-06 | 4.17E-05 |
| 14 - 15 | 4.76E-03 | 0. | 3.86E-03 | 5.09E-03 | 5.49E-03 | 5.82E-03 | 6.34E-03 | 2.78E-05 | 1.22E-06 | 9.52E-06 | 4.25E-05 |
| 15 - 16 | 4.29E-03 | 0. | 3.16E-03 | 4.41E-03 | 4.88E-03 | 5.08E-03 | 5.42E-03 | 2.77E-05 | 1.21E-06 | 9.27E-06 | 4.14E-05 |
| 16 - 17 | 3.91E-03 | 0. | 2.55E-03 | 3.94E-03 | 4.35E-03 | 4.75E-03 | 5.18E-03 | 2.68E-05 | 1.17E-06 | 8.51E-06 | 3.81E-05 |
| 17 - 18 | 3.57E-03 | 0. | 2.35E-03 | 3.61E-03 | 3.89E-03 | 4.30E-03 | 4.48E-03 | 2.51E-05 | 1.10E-06 | 7.46E-06 | 3.33E-05 |
| 18 - 19 | 3.22E-03 | 0. | 2.23E-03 | 3.29E-03 | 3.41E-03 | 3.75E-03 | 3.82E-03 | 2.27E-05 | 0. | 6.22E-06 | 2.78E-05 |
| 19 - 20 | 2.87E-03 | 0. | 2.12E-03 | 2.96E-03 | 2.98E-03 | 3.28E-03 | 3.19E-03 | 1.97E-05 | 0. | 4.39E-06 | 2.23E-05 |
| 20 - 21 | 2.49E-03 | 0. | 2.00E-03 | 2.61E-03 | 2.56E-03 | 2.77E-03 | 2.59E-03 | 1.67E-05 | 0. | 3.98E-06 | 1.73E-05 |
| 21 - 22 | 2.13E-03 | 0. | 1.83E-03 | 2.26E-03 | 2.13E-03 | 2.26E-03 | 2.08E-03 | 1.39E-05 | 0. | 3.13E-06 | 1.42E-05 |
| 22 - 23 | 1.79E-03 | 0. | 1.61E-03 | 1.88E-03 | 1.73E-03 | 1.85E-03 | 1.65E-03 | 1.16E-05 | 0. | 2.49E-06 | 1.11E-05 |
| 23 - 24 | 1.46E-03 | 0. | 1.40E-03 | 1.53E-03 | 1.37E-03 | 1.51E-03 | 1.27E-03 | 9.26E-06 | 0. | 1.92E-06 | 8.56E-06 |
| 24 - 25 | 1.18E-03 | 0. | 1.18E-03 | 1.25E-03 | 1.11E-03 | 1.23E-03 | 9.63E-04 | 7.29E-06 | 0. | 1.51E-06 | 6.74E-06 |
| 25 - 30 | 6.03E-04 | 0. | 6.39E-04 | 6.81E-04 | 5.36E-04 | 6.42E-04 | 4.44E-04 | 1.10E-05 | 1.11E-05 | 2.80E-05 | 2.85E-05 |
| 30 - 35 | 2.29E-04 | 0. | 2.49E-04 | 2.75E-04 | 1.85E-04 | 1.82E-04 | 1.52E-04 | 2.38E-06 | 3.43E-06 | 6.43E-06 | 6.54E-06 |
| 35 - 40 | 7.81E-05 | 0. | 8.33E-05 | 9.72E-05 | 5.45E-05 | 1.02E-04 | 4.69E-05 | 1.66E-06 | 1.63E-06 | 2.09E-06 | 2.12E-06 |
| 40 - 45 | 3.14E-05 | 0. | 3.37E-05 | 4.02E-05 | 2.34E-05 | 4.33E-05 | 1.72E-05 | 0. | 0. | 0. | 0. |
| 45 - 50 | 1.43E-05 | 0. | 1.54E-05 | 1.90E-05 | 1.11E-05 | 2.03E-05 | 8.02E-06 | 0. | 0. | 0. | 0. |
| 50 - 70 | 2.03E-06 | 0. | 2.17E-06 | 2.58E-06 | 1.83E-06 | 2.66E-06 | 1.56E-06 | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | CLEAR $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | HAZY $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 5.39E-02 | 4.58E-02 |
| MARITIME | 2.73E-03 | 2.97E-02 | 2.97E-02 | 3.24E-01 |
| TROPOSPHERIC | 4.58E-04 | 6.88E-04 | ******** | ******** |

WAVELENGTH = 4.037394 MICROMETERS
FREQUENCY = 2025.360 WAVENUMBER

| h(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.09E-01 | 0. | 2.65E-01 | 5.63E-01 | 6.83E-02 | 3.21E-01 | 2.77E-02 | 1.43E-03 | 5.36E-03 | 1.56E-02 | 5.84E-02 |
| 0 - 1 | 1.61E-01 | 0. | 6.46E-01 | 4.26E-01 | 7.74E-02 | 2.40E-01 | 2.66E-02 | 9.45E-04 | 3.55E-03 | 1.56E-02 | 5.84E-02 |
| 1 - 2 | 9.32E-02 | 0. | 3.77E-01 | 2.33E-01 | 4.75E-02 | 1.38E-01 | 2.07E-02 | 1.10E-04 | 1.54E-04 | 1.76E-03 | 2.44E-03 |
| 2 - 3 | 5.03E-02 | 0. | 1.92E-01 | 1.17E-01 | 2.92E-02 | 7.61E-02 | 1.33E-02 | 5.64E-05 | 7.83E-05 | 2.97E-04 | 4.16E-04 |
| 3 - 4 | 2.83E-02 | 0. | 7.75E-02 | 5.45E-02 | 1.44E-02 | 4.04E-02 | 7.46E-03 | 4.60E-05 | 6.43E-05 | 1.62E-04 | 2.27E-04 |
| 4 - 5 | 1.23E-02 | 0. | 3.44E-02 | 2.44E-02 | 6.64E-03 | 2.04E-02 | 3.32E-03 | 3.54E-05 | 4.96E-05 | 8.45E-05 | 1.18E-04 |
| 5 - 6 | 5.87E-03 | 0. | 1.76E-02 | 1.14E-02 | 3.08E-03 | 9.35E-03 | 1.35E-03 | 2.63E-05 | 3.68E-05 | 5.36E-05 | 7.50E-05 |
| 6 - 7 | 2.74E-03 | 0. | 7.98E-03 | 5.67E-03 | 1.22E-03 | 4.09E-03 | 5.73E-04 | 1.82E-05 | 2.54E-05 | 4.33E-05 | 6.14E-05 |
| 7 - 8 | 1.29E-03 | 0. | 3.48E-03 | 2.70E-03 | 4.70E-04 | 1.62E-03 | 1.84E-04 | 1.15E-05 | 1.61E-05 | 2.93E-05 | 4.11E-05 |
| 8 - 9 | 4.92E-04 | 0. | 1.43E-03 | 1.24E-03 | 1.57E-04 | 5.17E-04 | 6.50E-05 | 4.94E-05 | 1.84E-06 | 8.35E-06 | 3.13E-05 |
| 9 - 10 | 1.62E-04 | 0. | 5.77E-04 | 5.59E-04 | 5.64E-05 | 1.40E-04 | 4.15E-05 | 7.69E-05 | 1.37E-06 | 6.10E-06 | 2.32E-05 |
| 10 - 11 | 6.09E-05 | 0. | 1.98E-04 | 2.04E-04 | 3.86E-05 | 6.29E-05 | 2.61E-05 | 4.13E-05 | 1.17E-06 | 6.59E-06 | 2.51E-05 |
| 11 - 12 | 2.77E-05 | 0. | 5.10E-05 | 5.80E-05 | 2.92E-05 | 3.70E-05 | 1.70E-05 | 2.87E-05 | 1.07E-06 | 7.58E-06 | 2.89E-05 |
| 12 - 13 | 1.40E-05 | 0. | 1.93E-05 | 1.84E-05 | 1.59E-05 | 1.81E-05 | 1.11E-05 | 2.69E-05 | 1.00E-06 | 8.73E-06 | 3.33E-05 |
| 13 - 14 | 7.83E-06 | 0. | 9.13E-06 | 9.14E-06 | 7.83E-06 | 8.98E-06 | 7.07E-06 | 2.65E-05 | 0. | 9.44E-06 | 3.61E-05 |
| 14 - 15 | 5.19E-06 | 0. | 6.13E-06 | 6.20E-06 | 5.18E-06 | 6.05E-06 | 4.67E-06 | 2.69E-05 | 1.01E-06 | 9.68E-06 | 3.69E-05 |
| 15 - 16 | 3.81E-06 | 0. | 4.26E-06 | 4.35E-06 | 3.72E-06 | 4.25E-06 | 3.34E-06 | 2.68E-05 | 1.00E-06 | 9.43E-06 | 3.59E-05 |
| 16 - 17 | 2.80E-06 | 0. | 2.92E-06 | 3.17E-06 | 2.73E-06 | 3.23E-06 | 2.47E-06 | 2.53E-05 | 0. | 8.65E-06 | 3.31E-05 |
| 17 - 18 | 2.07E-06 | 0. | 2.14E-06 | 2.39E-06 | 2.05E-06 | 2.61E-06 | 1.85E-06 | 2.43E-05 | 0. | 7.56E-06 | 2.89E-05 |
| 18 - 19 | 1.58E-06 | 0. | 1.63E-06 | 1.83E-06 | 1.56E-06 | 1.99E-06 | 1.40E-06 | 2.20E-05 | 0. | 6.32E-06 | 2.41E-05 |
| 19 - 20 | 1.26E-06 | 0. | 1.21E-06 | 1.44E-06 | 1.22E-06 | 1.61E-06 | 1.08E-06 | 1.91E-05 | 0. | 5.07E-06 | 1.93E-05 |
| 20 - 21 | 1.06E-06 | 0. | 0. | 1.20E-06 | 1.01E-06 | 1.33E-06 | 0. | 1.61E-05 | 0. | 4.05E-06 | 1.54E-05 |
| 21 - 22 | 0. | 0. | 0. | 1.08E-06 | 0. | 1.22E-06 | 0. | 1.35E-05 | 0. | 3.23E-06 | 1.23E-05 |
| 22 - 23 | 0. | 0. | 0. | 1.01E-06 | 0. | 1.13E-06 | 0. | 1.12E-05 | 0. | 2.52E-06 | 9.59E-06 |
| 23 - 24 | 0. | 0. | 0. | 1.07E-06 | 0. | 1.23E-06 | 0. | 8.98E-06 | 0. | 1.95E-06 | 7.42E-06 |
| 24 - 25 | 1.04E-06 | 0. | 0. | 1.20E-06 | 0. | 1.48E-06 | 0. | 7.07E-06 | 0. | 1.53E-06 | 5.84E-06 |
| 25 - 30 | 1.18E-06 | 0. | 1.39E-06 | 1.61E-06 | 0. | 1.95E-06 | 0. | 1.07E-05 | 1.08E-05 | 2.74E-05 | 2.76E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 3.83E-06 | 0. | 7.30E-06 | 3.37E-06 | 6.29E-06 | 6.34E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.62E-05 | 1.64E-05 | 2.04E-06 | 2.05E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 6.22E-02 | 4.43E-02 |
| MARITIME | 2.69E-03 | 2.87E-02 | 2.88E-02 | 3.12E-01 |
| TROPOSPHERIC | 1.70E-04 | 6.15E-04 | ******** | ******** |

WAVELENGTH = 2.911864 MICROMETERS
FREQUENCY = 3435.170 WAVENUMBERS

| h(Km) | U.S. STANDARD $\beta_m$(Km$^{-1}$) | U.S. STANDARD $\sigma_m$(Km$^{-1}$) | TROPICAL $\beta_m$(Km$^{-1}$) | MIDLAT SUMMER $\beta_m$(Km$^{-1}$) | MIDLAT WINTER $\beta_m$(Km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(Km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(Km$^{-1}$) | AEROSOL CLEAR $\beta_a$(Km$^{-1}$) | AEROSOL CLEAR $\sigma_a$(Km$^{-1}$) | AEROSOL HAZY $\beta_a$(Km$^{-1}$) | AEROSOL HAZY $\sigma_a$(Km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.66E-01 | 1.49E-05 | 4.97E-01 | 5.78E-01 | 1.35E-01 | 4.04E-01 | 4.30E-02 | 7.12E-02 | 5.69E-03 | 3.79E-02 | 6.20E-02 |
| 0 - 1 | 2.11E-01 | 1.36E-05 | 7.69E-01 | 5.27E-01 | 1.09E-01 | 3.14E-01 | 3.90E-02 | 2.06E-02 | 3.77E-04 | 3.39E-02 | 5.70E-02 |
| 1 - 2 | 1.70E-01 | 1.23E-05 | 4.73E-01 | 3.06E-01 | 7.04E-02 | 1.83E-01 | 3.20E-02 | 7.88E-04 | 4.70E-04 | 6.17E-03 | 6.85E-03 |
| 2 - 3 | 7.50E-02 | 1.11E-05 | 2.66E-01 | 1.68E-01 | 4.41E-02 | 1.12E-01 | 2.18E-02 | 1.99E-04 | 2.20E-04 | 1.04E-03 | 1.16E-03 |
| 3 - 4 | 4.34E-02 | 1.00E-05 | 1.49E-01 | 8.98E-02 | 2.73E-02 | 6.51E-02 | 1.70E-02 | 1.62E-04 | 1.79E-04 | 5.71E-04 | 6.34E-04 |
| 4 - 5 | 2.10E-02 | 9.03E-06 | 5.26E-02 | 3.80E-02 | 1.14E-02 | 3.32E-02 | 8.30E-03 | 1.24E-04 | 1.38E-04 | 2.97E-04 | 3.30E-04 |
| 5 - 6 | 1.07E-02 | 8.11E-06 | 2.97E-02 | 1.93E-02 | 5.87E-03 | 1.68E-02 | 2.77E-03 | 9.24E-05 | 1.03E-04 | 1.89E-04 | 2.09E-04 |
| 6 - 7 | 6.33E-03 | 7.26E-06 | 1.73E-02 | 1.02E-02 | 2.55E-03 | 7.65E-03 | 1.52E-03 | 6.38E-05 | 7.09E-05 | 1.54E-04 | 1.71E-04 |
| 7 - 8 | 2.61E-03 | 6.48E-06 | 6.51E-03 | 5.16E-03 | 1.02E-03 | 3.29E-03 | 5.33E-04 | 4.04E-05 | 4.49E-05 | 1.03E-04 | 1.14E-04 |
| 8 - 9 | 1.14E-03 | 5.76E-06 | 2.89E-03 | 2.56E-03 | 4.67E-04 | 1.12E-03 | 2.65E-04 | 5.17E-05 | 5.44E-06 | 2.30E-05 | 1.37E-04 |
| 9 - 10 | 4.52E-04 | 5.11E-06 | 1.19E-03 | 1.25E-03 | 2.52E-04 | 4.30E-04 | 1.58E-04 | 3.85E-05 | 6.28E-06 | 1.68E-05 | 9.93E-05 |
| 10 - 11 | 2.19E-04 | 4.52E-06 | 4.67E-04 | 5.24E-04 | 1.60E-04 | 2.29E-04 | 1.34E-04 | 3.29E-05 | 5.36E-06 | 1.82E-05 | 1.08E-04 |
| 11 - 12 | 1.29E-04 | 3.99E-06 | 1.96E-04 | 2.04E-04 | 1.12E-04 | 1.54E-04 | 9.71E-05 | 3.01E-05 | 4.82E-06 | 2.09E-05 | 1.24E-04 |
| 12 - 13 | 8.42E-05 | 3.56E-06 | 1.07E-04 | 1.02E-04 | 8.60E-05 | 9.74E-05 | 7.01E-05 | 2.81E-05 | 4.59E-06 | 2.41E-05 | 1.43E-04 |
| 13 - 14 | 5.84E-05 | 2.97E-06 | 6.62E-05 | 6.67E-05 | 6.53E-05 | 6.63E-05 | 5.03E-05 | 2.77E-05 | 4.92E-06 | 2.62E-05 | 1.56E-04 |
| 14 - 15 | 4.25E-05 | 2.45E-06 | 4.33E-05 | 5.03E-05 | 4.11E-05 | 4.58E-05 | 3.66E-05 | 2.82E-05 | 4.60E-06 | 2.67E-05 | 1.59E-04 |
| 15 - 16 | 3.17E-05 | 2.03E-06 | 3.54E-05 | 3.61E-05 | 3.03E-05 | 3.47E-05 | 2.69E-05 | 2.81E-05 | 4.59E-06 | 2.60E-05 | 1.54E-04 |
| 16 - 17 | 2.35E-05 | 1.73E-06 | 2.45E-05 | 2.65E-05 | 2.24E-05 | 2.72E-05 | 1.99E-05 | 2.71E-05 | 4.43E-06 | 2.39E-05 | 1.42E-04 |
| 17 - 18 | 1.74E-05 | 1.53E-06 | 1.93E-05 | 1.99E-05 | 1.67E-05 | 2.04E-05 | 1.47E-05 | 2.54E-05 | 4.16E-06 | 2.09E-05 | 1.24E-04 |
| 18 - 19 | 1.23E-05 | 1.31E-06 | 1.71E-05 | 1.48E-05 | 1.23E-05 | 1.54E-05 | 1.09E-05 | 2.30E-05 | 3.76E-06 | 1.75E-05 | 1.04E-04 |
| 19 - 20 | 9.65E-06 | 1.13E-06 | 9.57E-06 | 1.11E-05 | 9.05E-06 | 1.17E-05 | 8.01E-06 | 2.03E-05 | 3.26E-06 | 1.40E-05 | 8.32E-05 |
| 20 - 21 | 7.26E-06 | 0. | 7.24E-06 | 8.42E-06 | 6.67E-06 | 9.71E-06 | 5.95E-06 | 1.63E-05 | 2.76E-06 | 1.12E-05 | 6.64E-05 |
| 21 - 22 | 5.54E-06 | 0. | 5.52E-06 | 6.45E-06 | 5.13E-06 | 6.69E-06 | 4.46E-06 | 1.41E-05 | 2.31E-06 | 8.82E-06 | 5.30E-05 |
| 22 - 23 | 4.25E-06 | 0. | 4.18E-06 | 4.97E-06 | 3.85E-06 | 5.10E-06 | 3.33E-06 | 1.17E-05 | 1.91E-06 | 6.95E-06 | 4.13E-05 |
| 23 - 24 | 3.29E-06 | 0. | 3.25E-06 | 3.81E-06 | 2.91E-06 | 3.95E-06 | 2.53E-06 | 9.40E-06 | 1.54E-06 | 5.37E-06 | 3.12E-05 |
| 24 - 25 | 2.57E-06 | 0. | 2.50E-06 | 3.01E-06 | 2.33E-06 | 3.14E-06 | 1.94E-06 | 7.40E-06 | 1.21E-06 | 4.23E-06 | 2.51E-05 |
| 25 - 30 | 1.23E-06 | 0. | 1.20E-06 | 1.50E-06 | 1.04E-06 | 1.55E-06 | 0. | 5.66E-06 | 2.16E-06 | 2.22E-06 | 5.52E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 2.67E-06 | 6.66E-06 | 5.09E-06 | 1.27E-05 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.31E-06 | 3.27E-06 | 1.65E-06 | 4.11E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.61E-06 | 0. | 1.61E-06 |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(Km$^{-1}$) | CLEAR $\sigma_a$(Km$^{-1}$) | HAZY $\beta_a$(Km$^{-1}$) | HAZY $\sigma_a$(Km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 8.58E-02 | 5.47E-02 |
| MARITIME | 1.85E-02 | 2.42E-02 | 2.03E-01 | 2.71E-01 |
| TROPOSPHERIC | 1.54E-03 | 1.71E-03 | ******** | ******** |

WAVELENGTH = 3.422618 MICROMETERS
FREQUENCY = 2921.741 WAVENUMBER

| Ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 7.38E-03 | 7.43E-06 | 2.31E-02 | 1.63E-02 | 4.83E-03 | 1.04E-02 | 3.03E-03 | 1.30E-03 | 6.50E-03 | 1.41E-02 | 7.06E-02 |
| 0 - 1 | 6.03E-03 | 7.09E-06 | 1.78E-02 | 1.26E-02 | 4.03E-03 | 8.14E-03 | 2.69E-03 | 2.97E-04 | 4.30E-03 | 1.41E-02 | 7.03E-02 |
| 1 - 2 | 3.93E-03 | 6.42E-06 | 1.09E-02 | 7.44E-03 | 2.82E-03 | 5.09E-03 | 2.10E-03 | 1.15E-04 | 2.74E-04 | 1.67E-03 | 5.96E-03 |
| 2 - 3 | 2.52E-03 | 5.81E-06 | 6.01E-03 | 4.18E-03 | 1.96E-03 | 3.23E-03 | 1.55E-03 | 5.35E-05 | 1.31E-04 | 7.82E-04 | 1.01E-03 |
| 3 - 4 | 1.62E-03 | 5.24E-06 | 2.89E-03 | 2.34E-03 | 1.33E-03 | 2.03E-03 | 1.13E-03 | 4.37E-05 | 1.56E-04 | 1.54E-04 | 5.52E-04 |
| 4 - 5 | 1.07E-03 | 4.72E-06 | 1.63E-03 | 1.38E-03 | 9.11E-04 | 1.29E-03 | 8.08E-04 | 3.33E-05 | 1.20E-04 | 8.03E-05 | 2.87E-04 |
| 5 - 6 | 7.40E-04 | 4.23E-06 | 1.05E-03 | 8.79E-04 | 6.52E-04 | 8.37E-04 | 5.93E-04 | 2.50E-05 | 9.92E-05 | 5.09E-05 | 1.82E-04 |
| 6 - 7 | 5.27E-04 | 3.79E-06 | 6.73E-04 | 6.12E-04 | 4.73E-04 | 5.59E-04 | 4.46E-04 | 1.73E-05 | 6.17E-05 | 4.15E-05 | 1.48E-04 |
| 7 - 8 | 3.86E-04 | 3.39E-06 | 4.56E-04 | 4.30E-04 | 3.51E-04 | 3.94E-04 | 3.37E-04 | 1.03E-05 | 3.83E-05 | 2.73E-05 | 9.96E-05 |
| 8 - 9 | 2.85E-04 | 3.01E-06 | 3.25E-04 | 3.11E-04 | 2.66E-04 | 2.85E-04 | 2.56E-04 | 9.65E-06 | 7.40E-06 | 1.60E-05 | 6.19E-05 |
| 9 - 10 | 2.13E-04 | 2.67E-06 | 2.34E-04 | 2.32E-04 | 2.03E-04 | 2.14E-04 | 1.98E-04 | 7.21E-06 | 5.51E-06 | 1.31E-05 | 6.71E-05 |
| 10 - 11 | 1.62E-04 | 2.36E-06 | 1.78E-04 | 1.73E-04 | 1.52E-04 | 1.61E-04 | 1.37E-04 | 6.14E-05 | 4.69E-06 | 1.42E-05 | 7.25E-05 |
| 11 - 12 | 1.21E-04 | 2.05E-06 | 1.33E-04 | 1.32E-04 | 1.12E-04 | 1.19E-04 | 1.00E-04 | 5.54E-05 | 4.31E-06 | 1.63E-05 | 8.34E-05 |
| 12 - 13 | 8.82E-05 | 1.75E-06 | 1.05E-04 | 1.01E-04 | 8.22E-05 | 8.67E-05 | 7.28E-05 | 5.26E-05 | 4.02E-06 | 1.86E-05 | 9.51E-05 |
| 13 - 14 | 6.43E-05 | 1.50E-06 | 7.70E-05 | 7.51E-05 | 6.00E-05 | 6.44E-05 | 5.32E-05 | 5.19E-05 | 3.96E-06 | 2.04E-05 | 1.04E-04 |
| 14 - 15 | 4.70E-05 | 1.29E-06 | 6.18E-05 | 5.66E-05 | 4.43E-05 | 4.83E-05 | 3.90E-05 | 5.27E-05 | 4.03E-06 | 2.08E-05 | 1.07E-04 |
| 15 - 16 | 3.43E-05 | 1.04E-06 | 4.67E-05 | 3.98E-05 | 3.24E-05 | 3.36E-05 | 2.84E-05 | 5.26E-05 | 4.02E-05 | 2.03E-05 | 1.04E-04 |
| 16 - 17 | 2.50E-05 | 0. | 3.30E-05 | 2.86E-05 | 2.37E-05 | 2.59E-05 | 2.09E-05 | 5.08E-05 | 3.89E-06 | 1.86E-05 | 9.52E-05 |
| 17 - 18 | 1.83E-05 | 0. | 2.37E-05 | 2.11E-05 | 1.75E-05 | 1.90E-05 | 1.53E-05 | 4.76E-05 | 3.64E-06 | 1.63E-05 | 8.34E-05 |
| 18 - 19 | 1.34E-05 | 0. | 1.63E-05 | 1.53E-05 | 1.27E-05 | 1.41E-05 | 1.12E-05 | 4.31E-05 | 3.30E-06 | 1.36E-05 | 6.96E-05 |
| 19 - 20 | 9.77E-06 | 0. | 1.12E-05 | 1.12E-05 | 9.24E-06 | 1.05E-05 | 8.19E-06 | 3.74E-05 | 2.86E-06 | 1.09E-05 | 5.58E-05 |
| 20 - 21 | 7.12E-06 | 0. | 7.89E-06 | 8.11E-06 | 6.65E-06 | 7.63E-06 | 6.00E-06 | 3.16E-05 | 2.42E-06 | 8.72E-06 | 4.46E-05 |
| 21 - 22 | 5.18E-06 | 0. | 5.54E-06 | 5.96E-06 | 4.96E-06 | 5.63E-06 | 4.38E-06 | 2.65E-05 | 2.02E-06 | 6.96E-06 | 3.56E-05 |
| 22 - 23 | 3.76E-06 | 0. | 3.90E-06 | 4.26E-06 | 3.61E-06 | 4.20E-06 | 3.20E-06 | 2.20E-05 | 1.68E-06 | 5.42E-06 | 2.77E-05 |
| 23 - 24 | 2.75E-06 | 0. | 2.82E-06 | 3.23E-06 | 2.60E-06 | 3.10E-06 | 2.34E-06 | 1.76E-05 | 1.35E-06 | 4.12E-06 | 2.14E-05 |
| 24 - 25 | 2.01E-06 | 0. | 2.07E-06 | 2.30E-06 | 1.99E-06 | 2.23E-06 | 1.71E-06 | 1.39E-05 | 1.06E-06 | 3.30E-06 | 1.64E-05 |
| 25 - 30 | 0. | 0. | 0. | 1.00E-06 | 0. | 0. | 0. | 1.04E-05 | 1.64E-05 | 2.66E-06 | 4.13E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 7.20E-06 | 5.05E-06 | 6.10E-06 | 9.63E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.54E-06 | 2.48E-06 | 1.99E-06 | 3.12E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.22E-06 | 0. | 1.22E-06 |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 6.71E-02 | 5.61E-02 |
| MARITIME | 4.79E-03 | 3.98E-02 | 5.22E-02 | 4.33E-01 |
| TROPOSPHERIC | 4.17E-04 | 1.49E-03 | ******** | ******** |

WAVELENGTH = 3.471378 MICROMETERS
FREQUENCY = 2880.700 WAVENUMBER

| ht(km) | U.S. STANDARD $\beta_m$(km$^{-1}$) | $\sigma_m$(km$^{-1}$) | TROPICAL $\beta_m$(km$^{-1}$) | MIDLAT SUMMER $\beta_m$(km$^{-1}$) | MIDLAT WINTER $\beta_m$(km$^{-1}$) | SUBARCTIC SUMMER $\beta_m$(km$^{-1}$) | SUBARCTIC WINTER $\beta_m$(km$^{-1}$) | AEROSOL CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | AEROSOL HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4.94E-03 | 7.02E-06 | 1.76E-02 | 1.24E-02 | 2.78E-03 | 7.70E-03 | 5.89E-04 | 1.17E-03 | 6.61E-03 | 1.23E-02 | 7.20E-02 |
| 0 - 1 | 3.90E-03 | 6.89E-06 | 1.36E-02 | 9.49E-03 | 2.19E-03 | 5.85E-03 | 8.38E-04 | 7.75E-04 | 4.37E-03 | 1.24E-02 | 7.20E-02 |
| 1 - 2 | 2.37E-03 | 6.07E-06 | 8.17E-03 | 5.34E-03 | 1.37E-03 | 3.43E-03 | 6.52E-04 | 3.17E-04 | 1.77E-03 | 1.46E-03 | 6.31E-03 |
| 2 - 3 | 1.34E-03 | 5.49E-06 | 4.29E-03 | 2.76E-03 | 8.27E-04 | 1.99E-03 | 4.27E-04 | 4.69E-05 | 1.93E-04 | 2.47E-04 | 1.02E-03 |
| 3 - 4 | 7.12E-04 | 4.95E-06 | 1.80E-03 | 1.35E-03 | 4.36E-04 | 1.10E-03 | 2.45E-04 | 3.82E-05 | 1.57E-04 | 1.35E-04 | 5.56E-04 |
| 4 - 5 | 3.65E-04 | 4.46E-06 | 9.56E-04 | 6.42E-04 | 2.11E-04 | 5.76E-04 | 1.16E-04 | 2.95E-05 | 1.21E-04 | 7.03E-05 | 2.89E-04 |
| 5 - 6 | 1.84E-04 | 4.00E-06 | 4.61E-04 | 3.12E-04 | 1.02E-04 | 2.79E-04 | 4.87E-05 | 2.19E-05 | 9.00E-05 | 4.46E-05 | 1.83E-04 |
| 6 - 7 | 9.05E-05 | 3.58E-06 | 2.22E-04 | 1.63E-04 | 4.29E-05 | 1.23E-04 | 2.14E-05 | 1.51E-05 | 6.22E-05 | 3.65E-05 | 1.50E-04 |
| 7 - 8 | 4.34E-05 | 3.20E-06 | 1.04E-04 | 8.24E-05 | 1.56E-05 | 5.45E-05 | 7.37E-06 | 9.56E-06 | 3.93E-05 | 2.44E-05 | 1.00E-04 |
| 8 - 9 | 1.80E-05 | 2.84E-06 | 4.54E-05 | 4.03E-05 | 6.18E-06 | 1.86E-05 | 2.72E-06 | 8.48E-05 | 7.38E-06 | 1.70E-05 | 8.82E-05 |
| 9 - 10 | 6.23E-06 | 2.52E-06 | 1.78E-05 | 1.92E-05 | 2.73E-06 | 5.77E-06 | 1.73E-06 | 7.05E-05 | 5.49E-06 | 1.24E-05 | 6.44E-05 |
| 10 - 11 | 2.47E-06 | 2.23E-06 | 6.18E-06 | 7.49E-06 | 1.60E-06 | 2.53E-06 | 1.10E-06 | 6.01E-05 | 4.68E-06 | 1.34E-05 | 6.96E-05 |
| 11 - 12 | 1.13E-06 | 1.94E-06 | 2.11E-06 | 2.30E-06 | 1.20E-06 | 1.50E-06 | 0. | 5.52E-05 | 4.23E-06 | 1.54E-05 | 8.01E-05 |
| 12 - 13 | 0. | 1.66E-06 | 0. | 0. | 0. | 0. | 0. | 5.15E-05 | 4.01E-06 | 1.77E-05 | 9.22E-05 |
| 13 - 14 | 0. | 1.42E-06 | 0. | 0. | 0. | 0. | 0. | 5.08E-05 | 3.95E-06 | 1.93E-05 | 1.00E-04 |
| 14 - 15 | 0. | 1.21E-06 | 0. | 0. | 0. | 0. | 0. | 5.16E-05 | 4.02E-06 | 1.97E-05 | 1.02E-04 |
| 15 - 16 | 0. | 1.03E-06 | 0. | 0. | 0. | 0. | 0. | 5.15E-05 | 4.01E-06 | 1.92E-05 | 9.96E-05 |
| 16 - 17 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 4.98E-05 | 3.87E-06 | 1.76E-05 | 9.14E-05 |
| 17 - 18 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 4.66E-05 | 3.63E-06 | 1.56E-05 | 8.01E-05 |
| 18 - 19 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 4.22E-05 | 3.29E-06 | 1.29E-05 | 6.68E-05 |
| 19 - 20 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.66E-05 | 2.85E-06 | 1.03E-05 | 5.35E-05 |
| 20 - 21 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.10E-05 | 2.41E-06 | 8.23E-06 | 4.28E-05 |
| 21 - 22 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 2.59E-05 | 2.02E-06 | 6.57E-06 | 3.42E-05 |
| 22 - 23 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 2.15E-05 | 1.67E-06 | 5.12E-06 | 2.66E-05 |
| 23 - 24 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.72E-05 | 1.34E-06 | 3.95E-06 | 2.06E-05 |
| 24 - 25 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.36E-05 | 1.06E-06 | 3.12E-06 | 1.62E-05 |
| 25 - 30 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.05E-05 | 1.50E-05 | 2.63E-06 | 4.19E-05 |
| 30 - 35 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 3.24E-06 | 4.94E-06 | 6.19E-06 | 9.41E-06 |
| 35 - 40 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.60E-06 | 2.43E-06 | 2.03E-06 | 3.05E-06 |
| 40 - 45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 7. | 1.20E-06 | 0. | 1.20E-06 |
| 45 - 50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 - 70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 70 -100 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

ALTERNATE BOUNDRY LAYER AEROSOL MODELS

| | CLEAR $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) | HAZY $\beta_a$(km$^{-1}$) | $\sigma_a$(km$^{-1}$) |
|---|---|---|---|---|
| URBAN | ******** | ******** | 6.69E-02 | 5.65E-02 |
| MARITIME | 3.59E-03 | 4.03E-02 | 3.90E-02 | 4.39E-01 |
| TROPOSPHERIC | 3.65E-04 | 1.50E-03 | ******** | ******** |

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# Atmospheric Transmission of Laser Radiation: Computer Code LASER

R.A. McClatchey
A.P. D'Agati

## Errata

Insert the following on page 111:

Figures C1 and C2 are based on the U.S. STANDARD ATMOSPHERE, 1962 model shown on page 31.

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AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASSACHUSETTS 01731

# Appendix C

## Calculated Transmission Spectra for 10-km Horizontal Paths at Sea Level and 12-km Altitude

Table C1 defines the spectral plots provided. Note that two have been omitted: Figure C1k because it is completely opaque over the entire spectral range and Figure C2c because it is completely transparent over the entire spectral range.

Table C1. Spectral Plots Contained in Figures C1 and C2

| Figure No. | Spectral Range ($cm^{-1}$) | Figure No. | Spectral Range ($cm^{-1}$) |
|---|---|---|---|
| C1a | 740-800 | C2a | 740-800 |
| C1b | 800-860 | C2b | 800-860 |
| C1c | 860-920 | C2c | 860-920 transparent |
| C1d | 920-980 | C2d | 920-980 |
| C1e | 980-1040 | C2e | 980-1040 |
| C1f | 1040-1100 | C2f | 1040-1100 |
| C1g | 1100-1160 | C2g | 1100-1160 |
| C1h | 1160-1220 | C2h | 1160-1220 |
| C1i | 1220-1280 | C2i | 1220-1280 |
| C1j | 1280-1340 | C2j | 1280-1340 |
| C1k | 1340-1400 opaque | C2k | 1340-1400 |
| C1l | 1880-1940 | C2l | 1880-1940 |
| C1m | 1940-2000 | C2m | 1940-2000 |
| C1n | 2000-2060 | C2n | 2000-2060 |
| C1o | 2060-2120 | C2o | 2060-2120 |
| C1p | 2120-2180 | C2p | 2120-2180 |
| C1q | 2360-2420 | C2q | 2360-2420 |
| C1r | 2420-2480 | C2r | 2420-2480 |
| C1s | 2480-2540 | C2s | 2480-2540 |
| C1t | 2540-2600 | C2t | 2540-2600 |
| C1u | 2600-2660 | C2u | 2600-2660 |
| C1v | 2660-2720 | C2v | 2660-2720 |
| C1w | 2720-2780 | C2w | 2720-2780 |
| C1x | 2780-2840 | C2x | 2780-2840 |
| C1y | 2840-2900 | C2y | 2840-2900 |
| C1z | 2900-2960 | C2z | 2900-2960 |

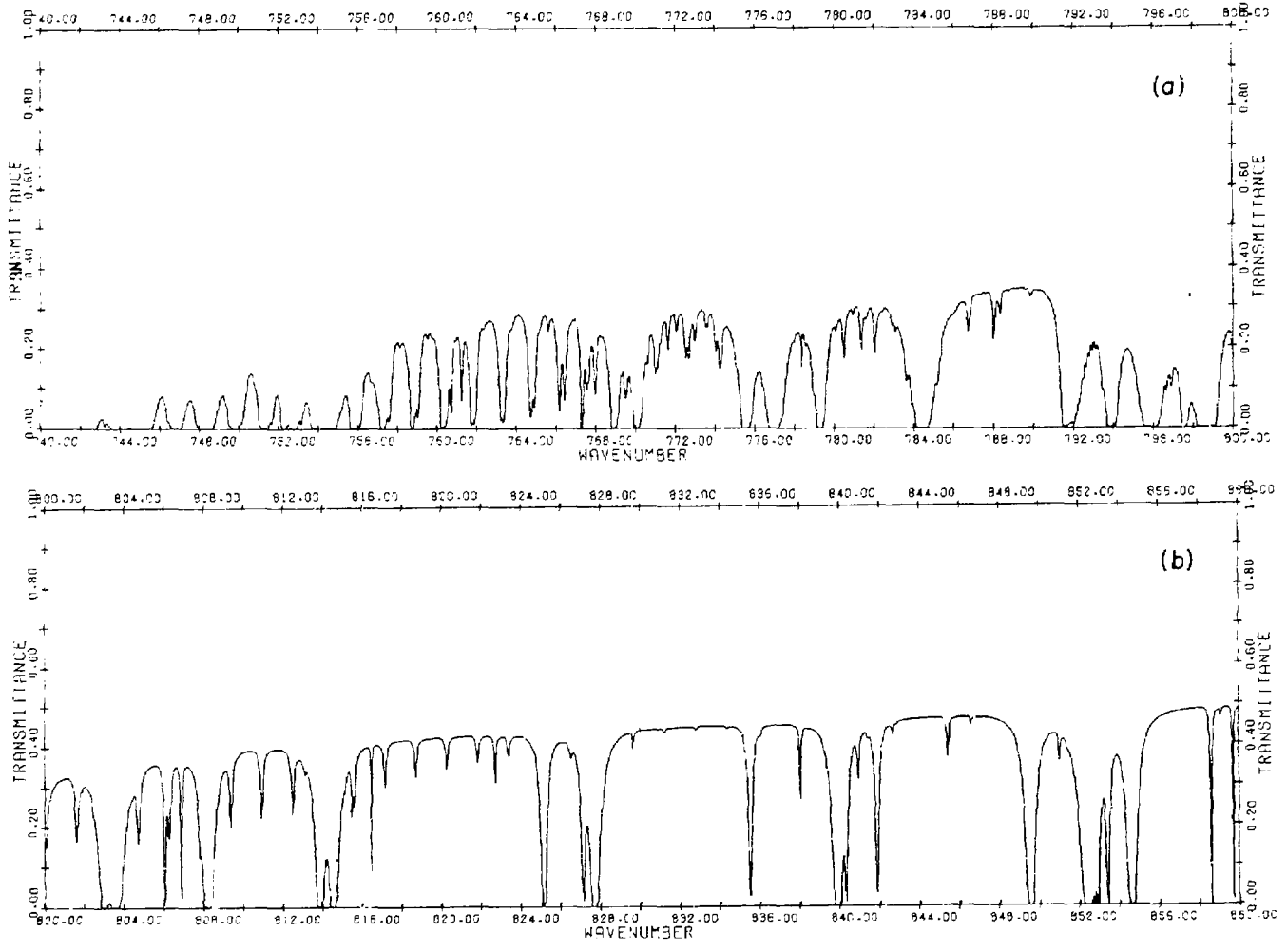


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$

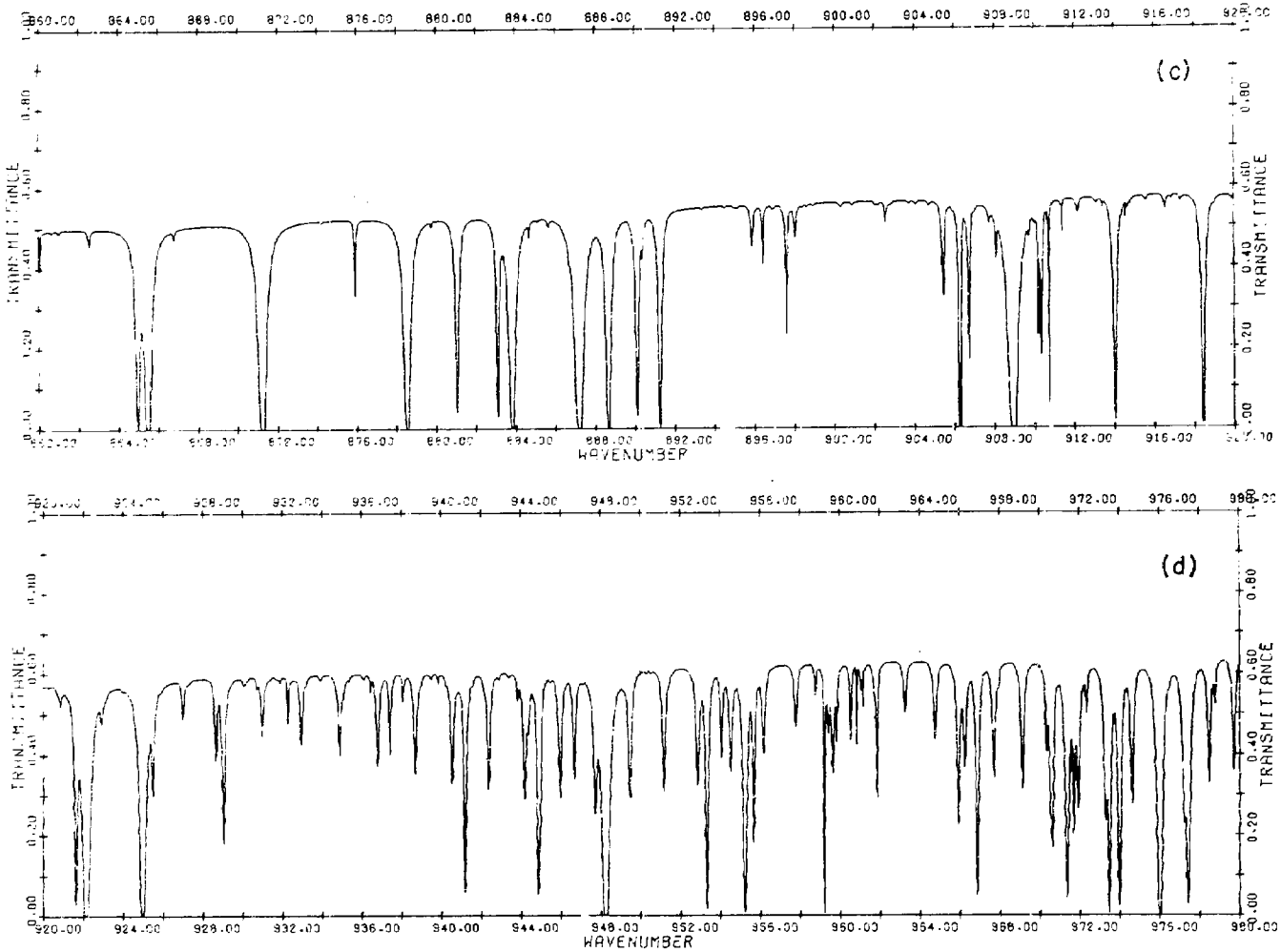


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

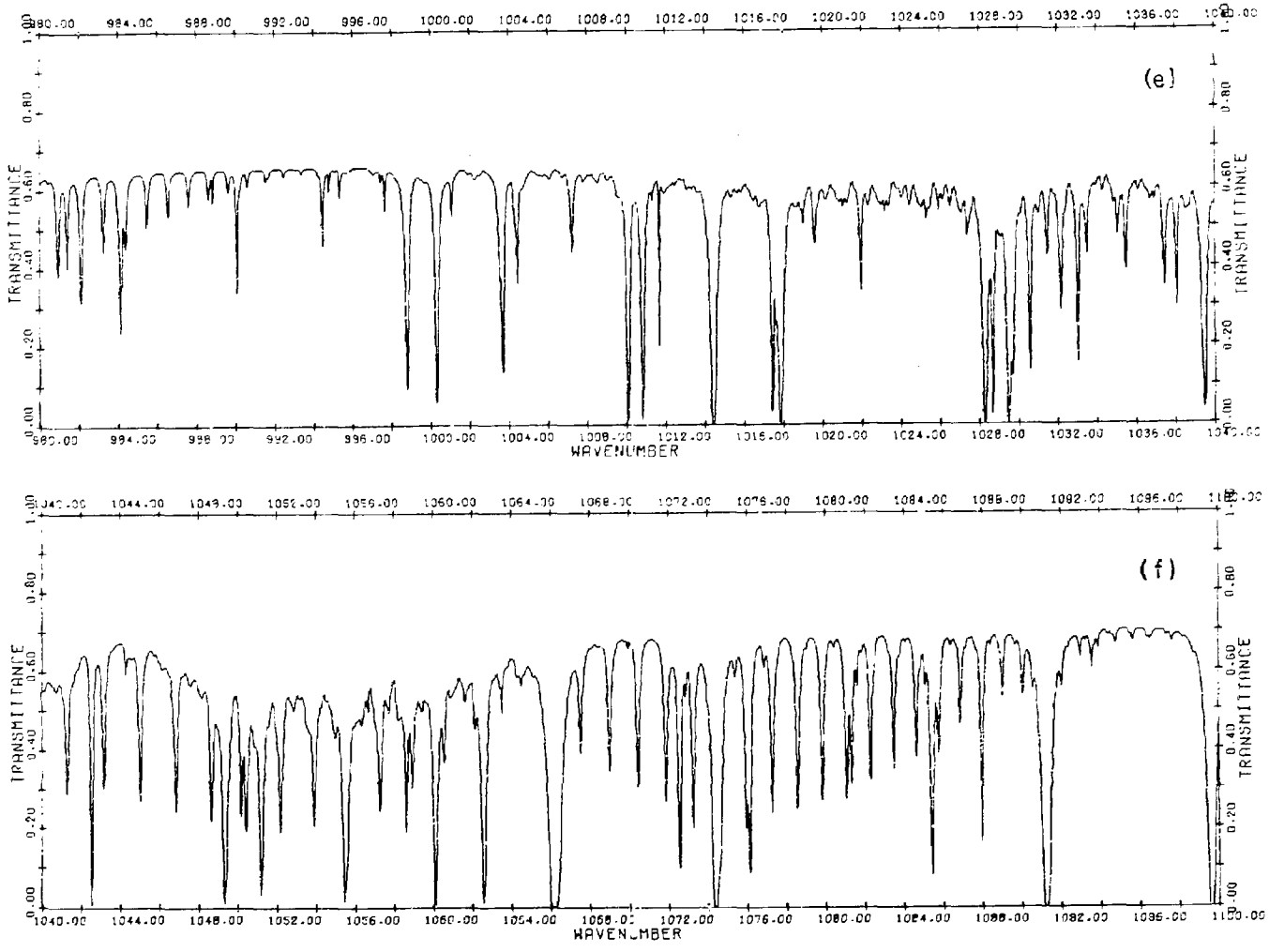


*Figure C1.* Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$ (Cont.)

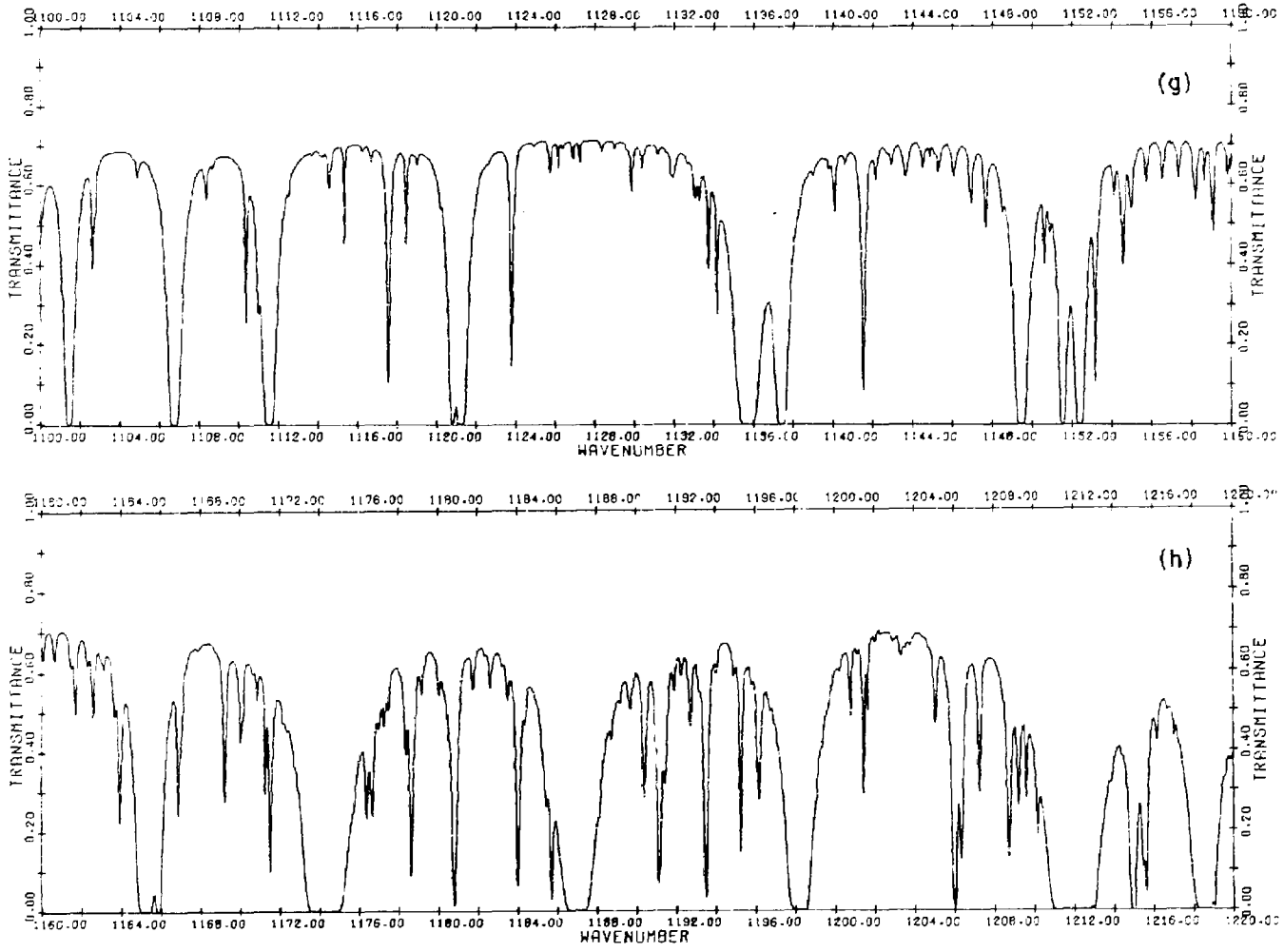


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$ (Cont.)

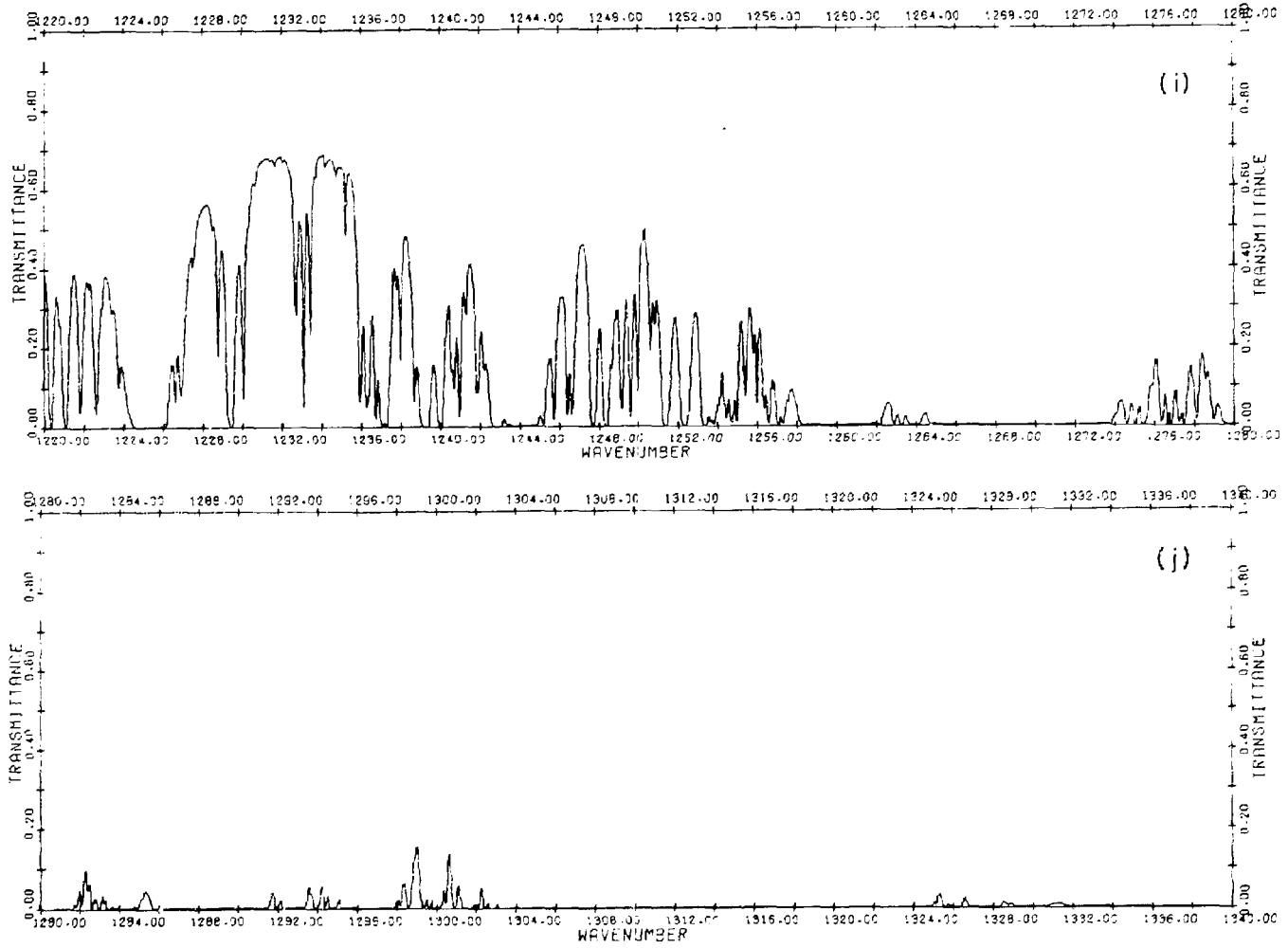


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$ (Cont.)

Note that Figure C1k has been omitted as indicated in Table C1 because the plotted spectrum appears opaque for the entire spectral range of the figure.

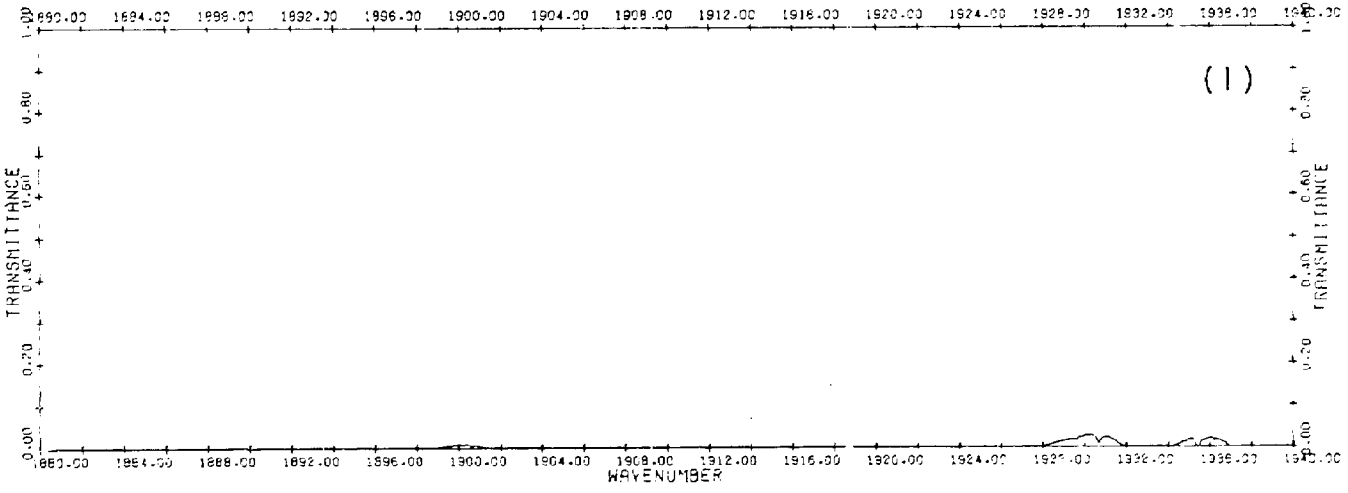


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$ (Cont.)

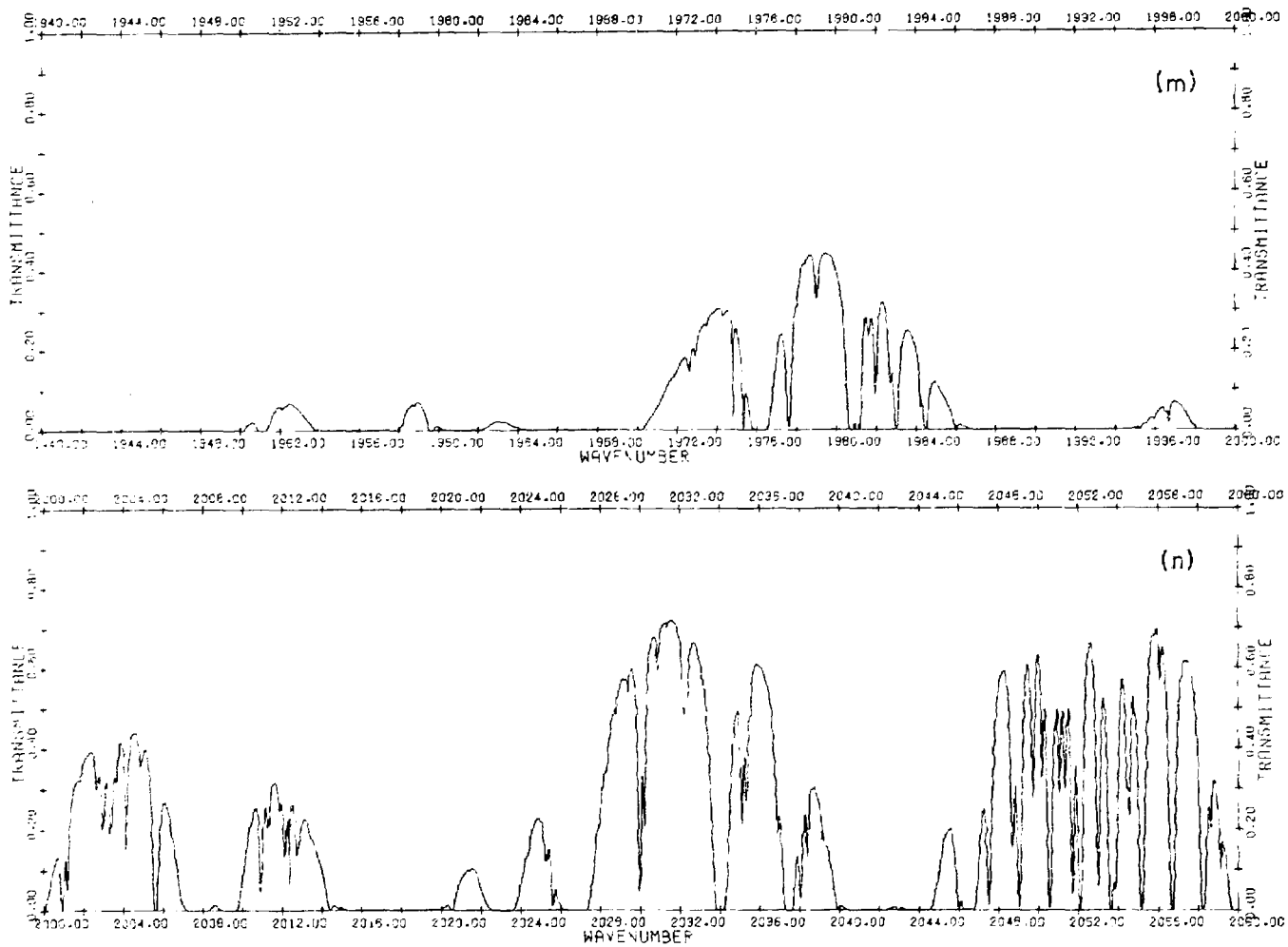


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$ (Cont.)

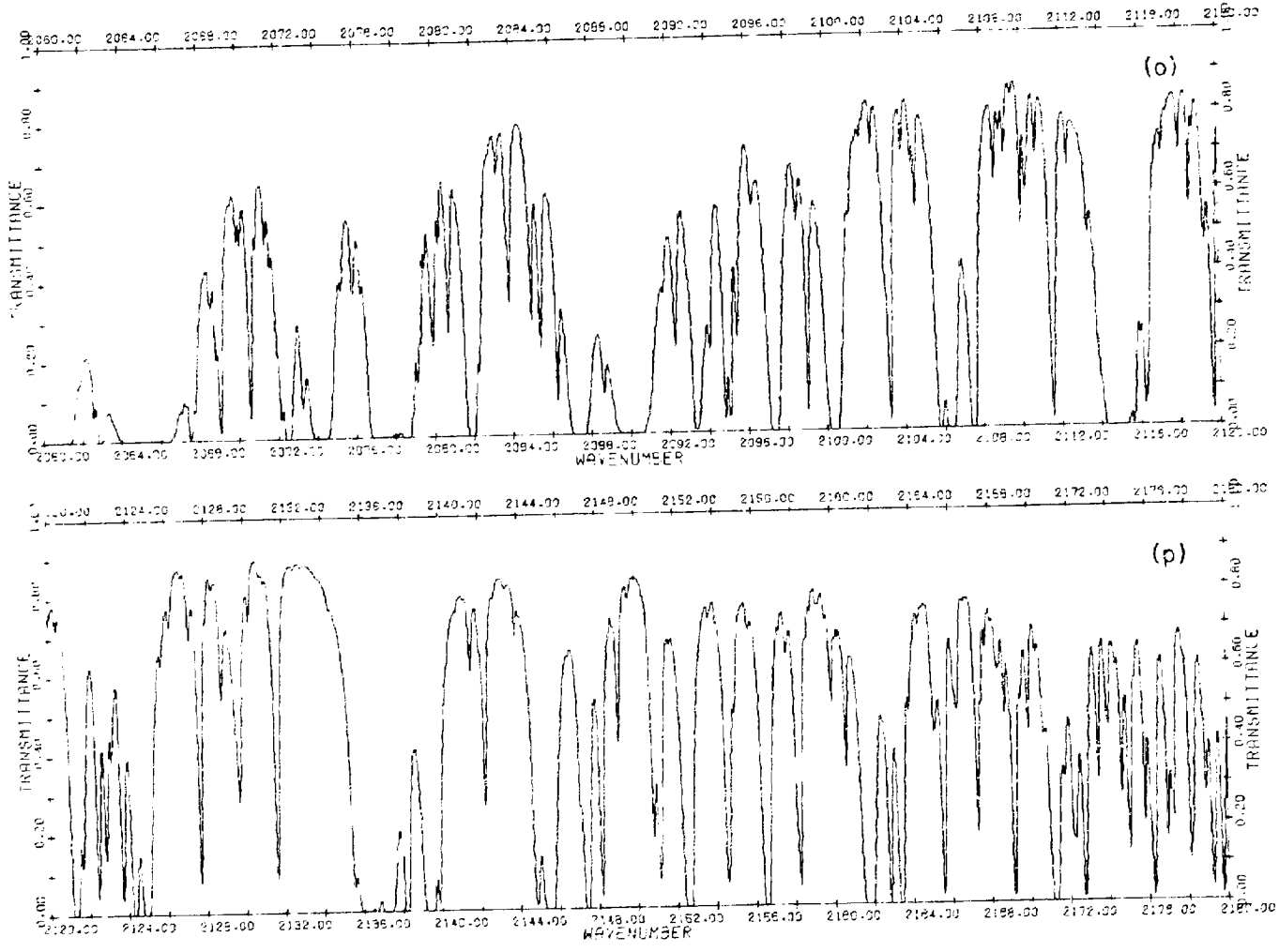


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

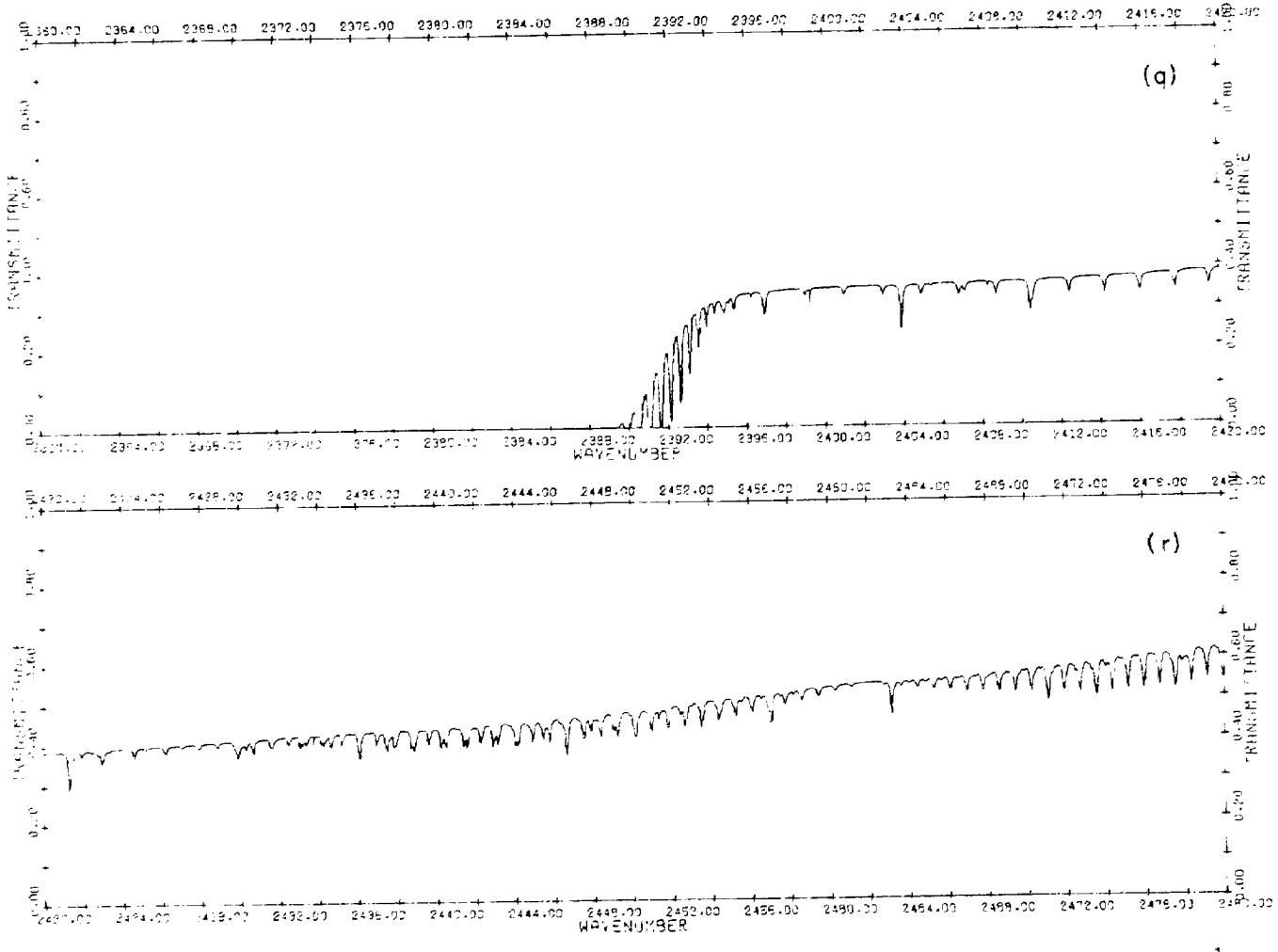


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

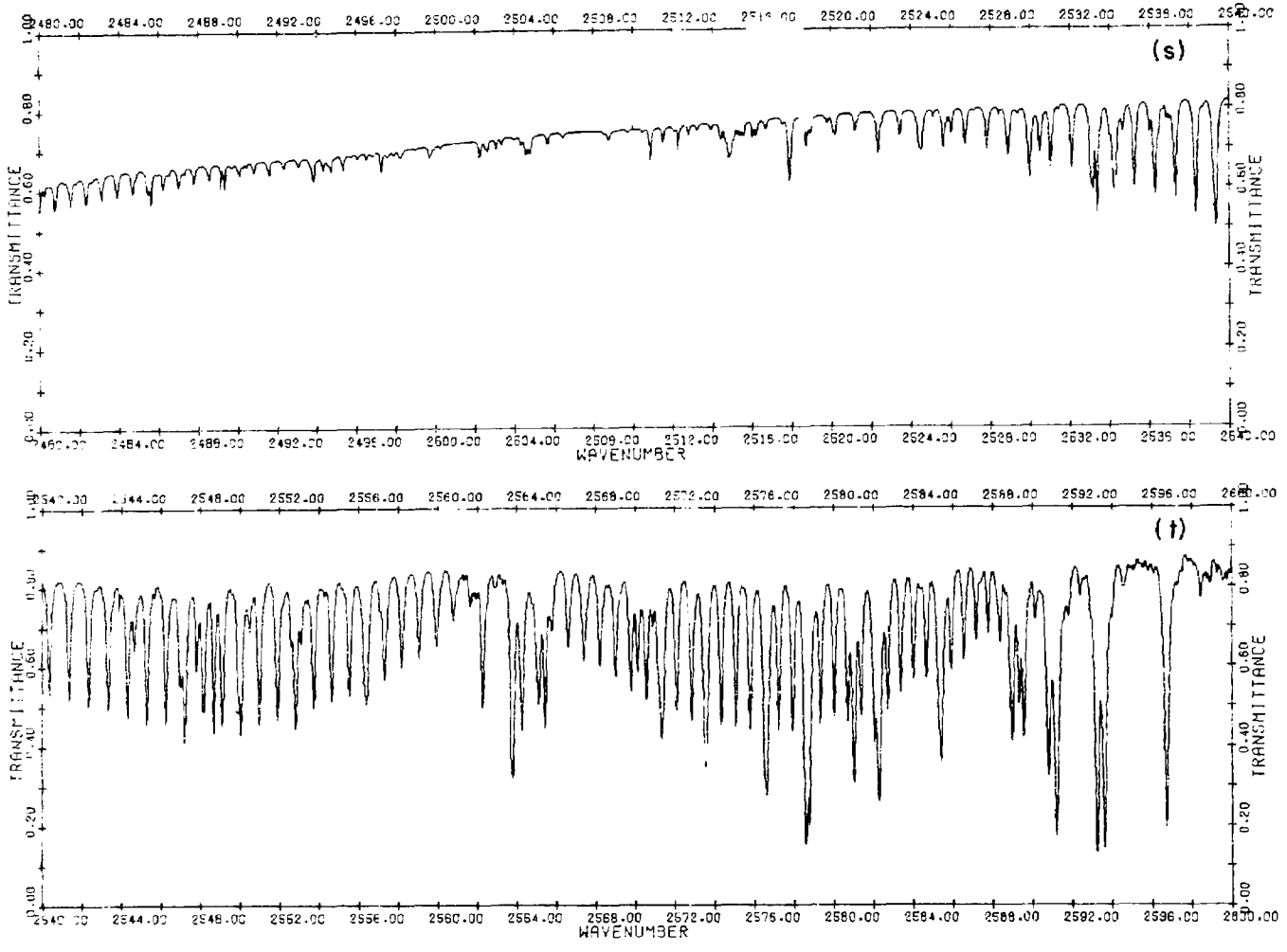


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

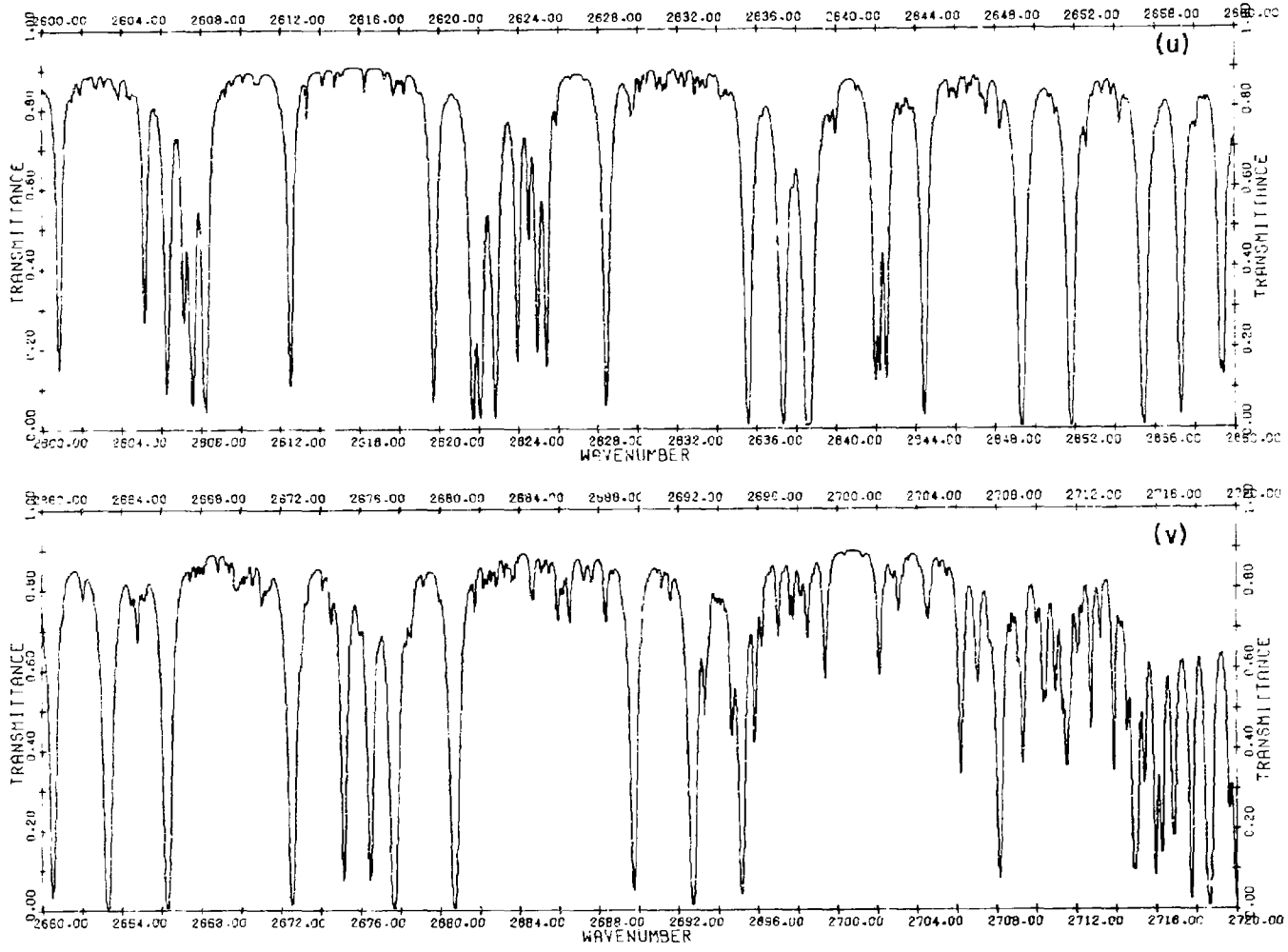


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$ (Cont.)

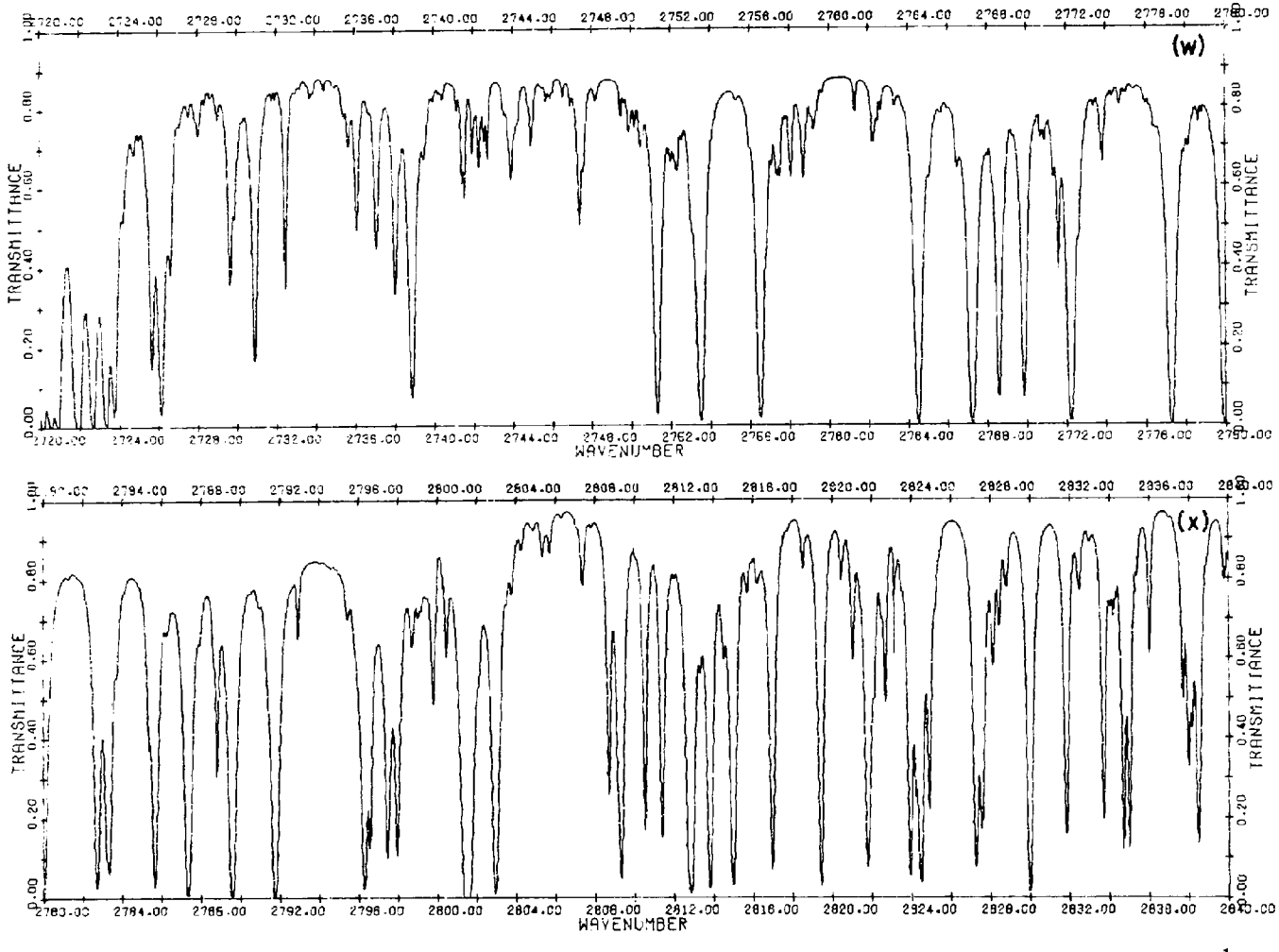


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

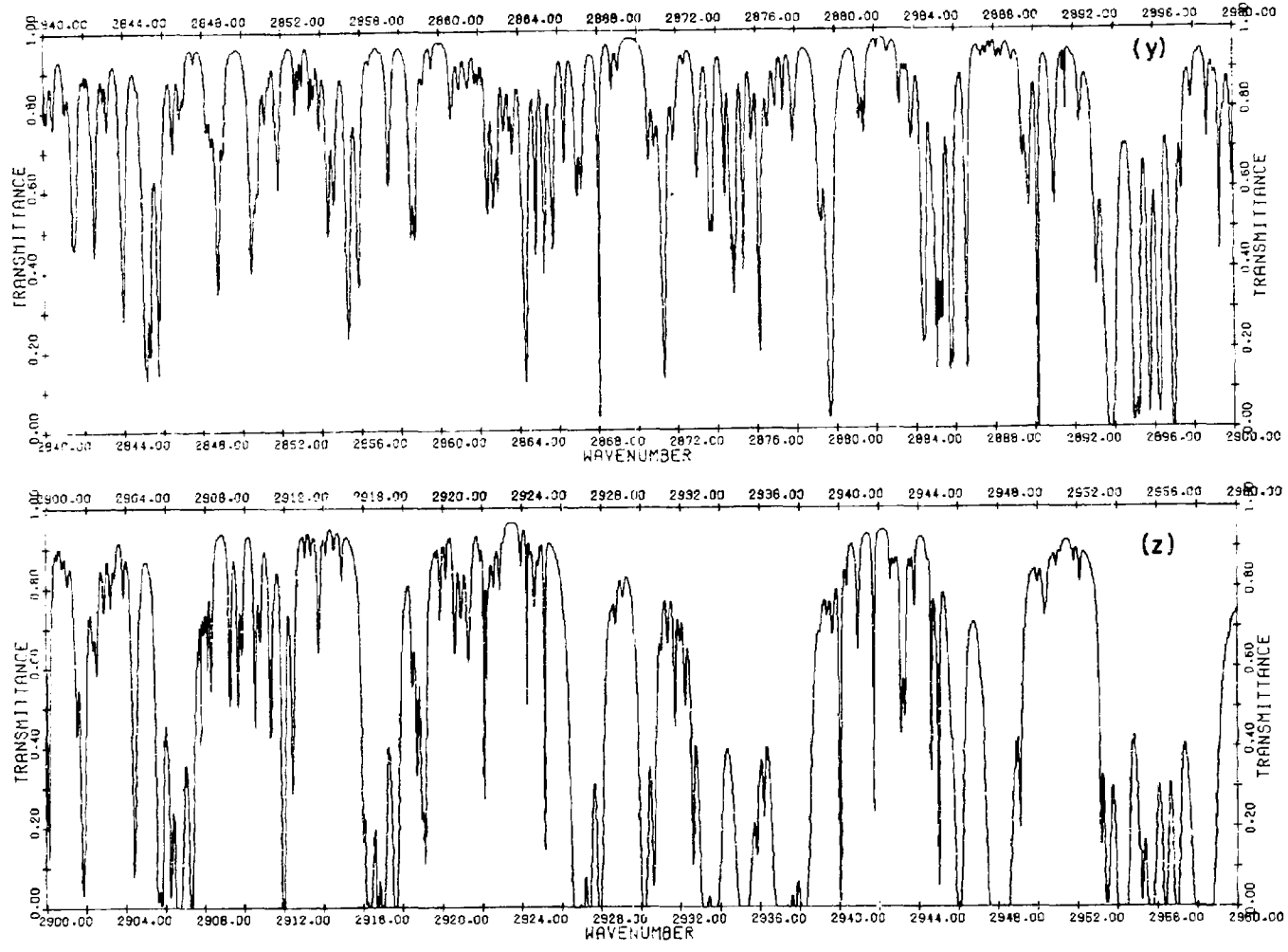


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

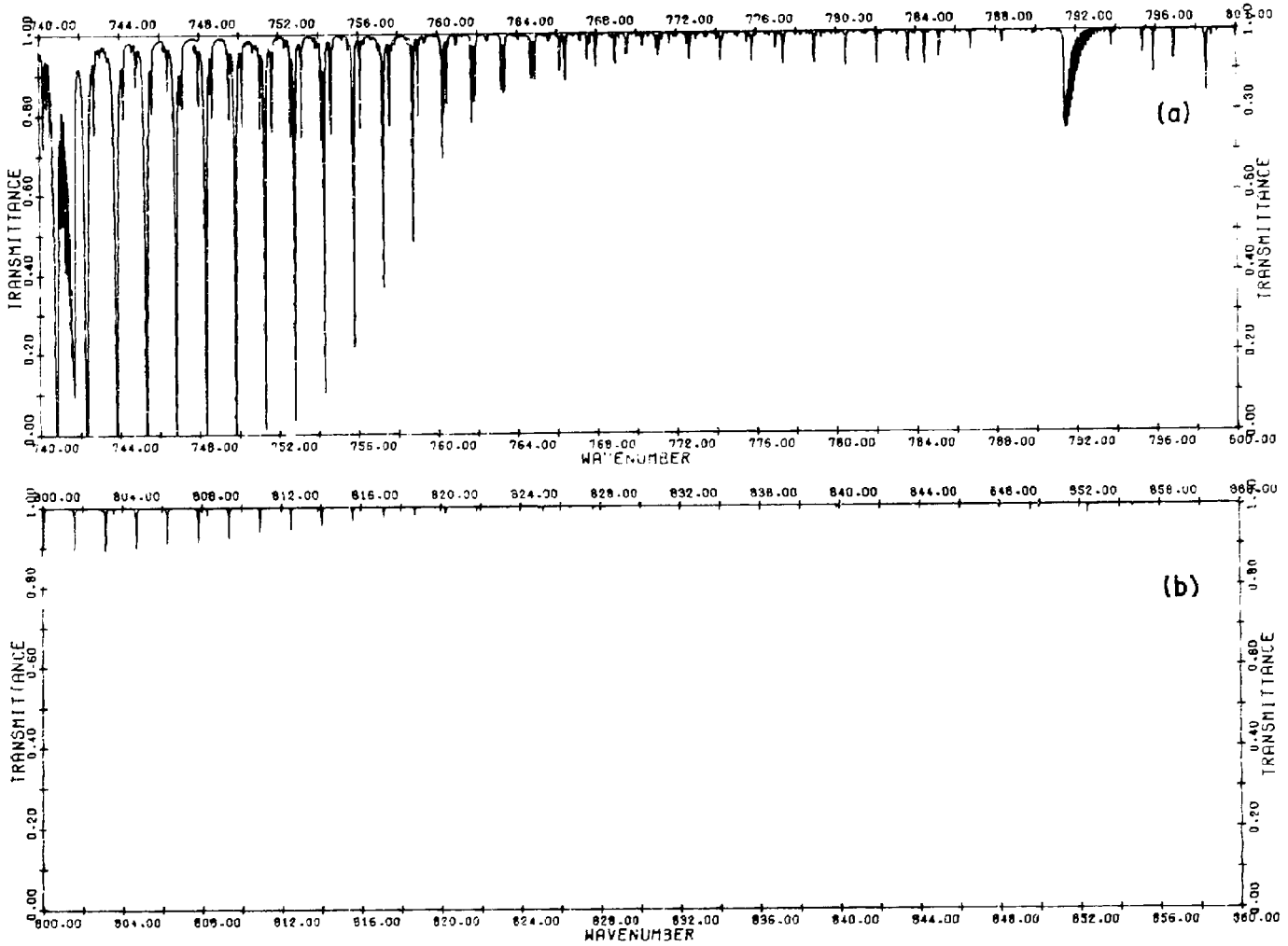


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$

Note that Figure C2c has been omitted as indicated in Table C1 because the plotted spectrum appears transparent for the entire spectral range of the figure.



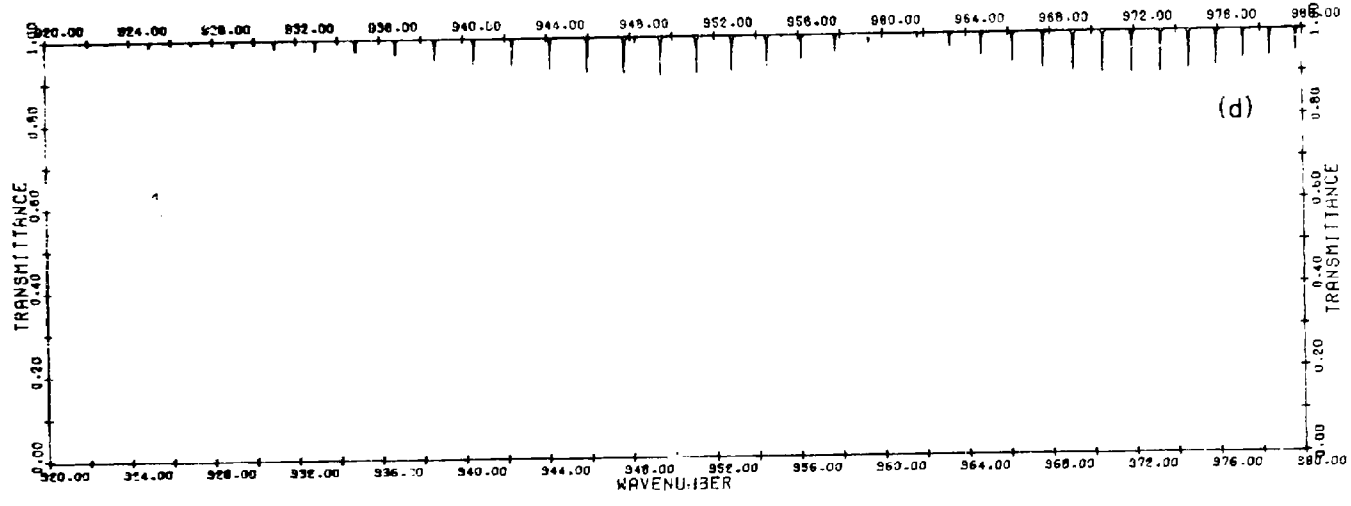


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

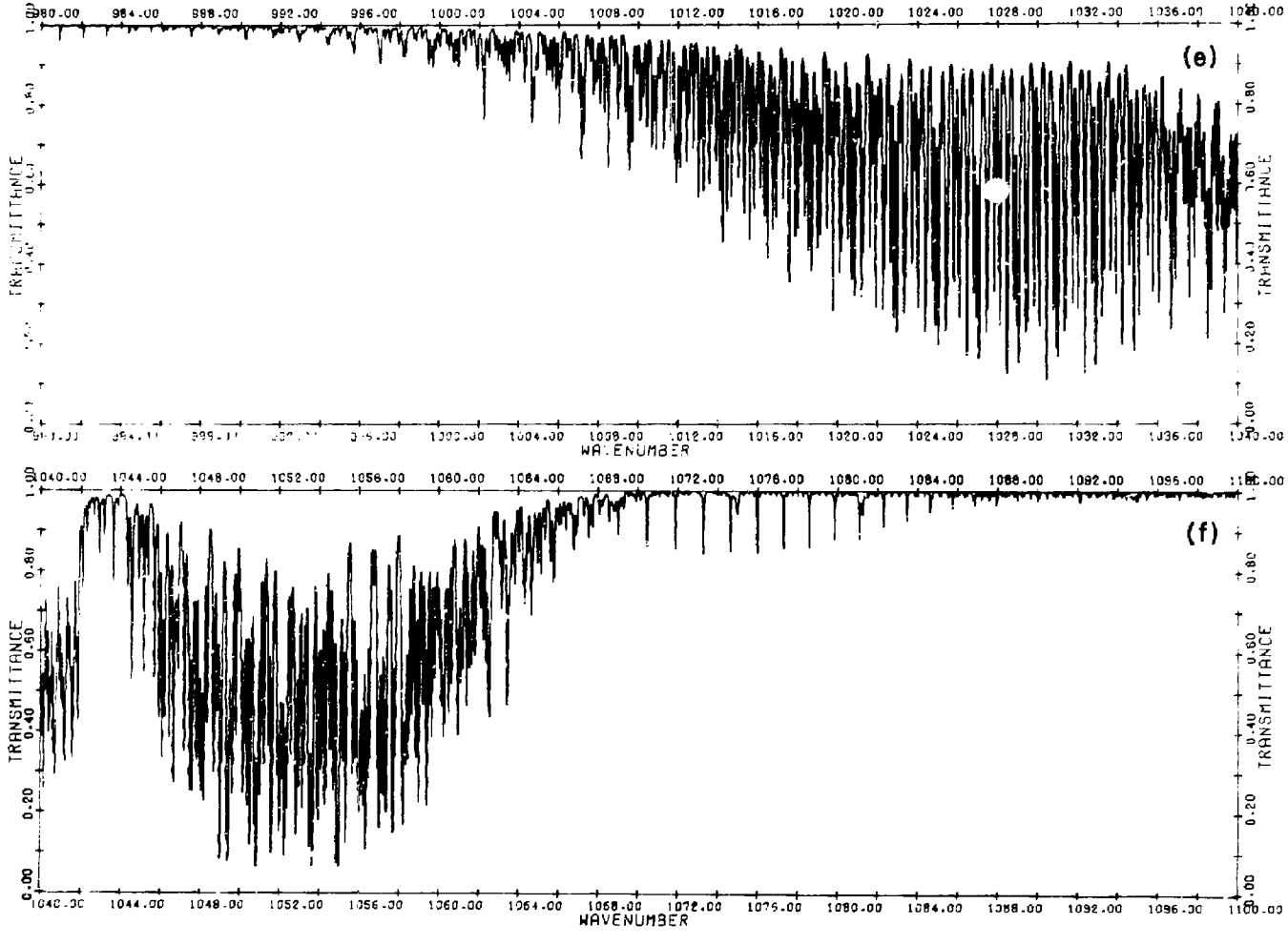


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$: EOUND value = 20 $cm^{-1}$ (Cont.)

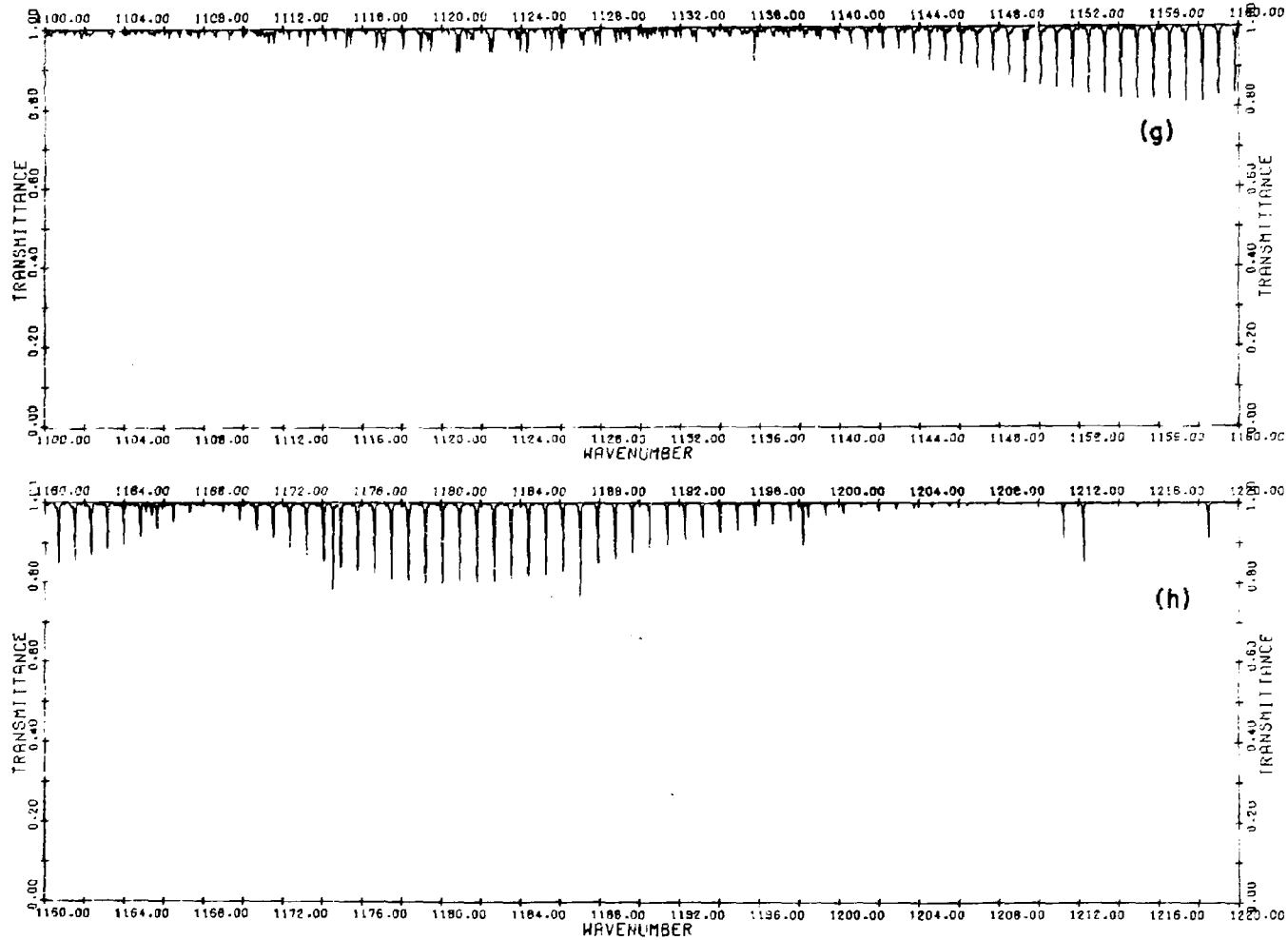


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$ (Cont.)

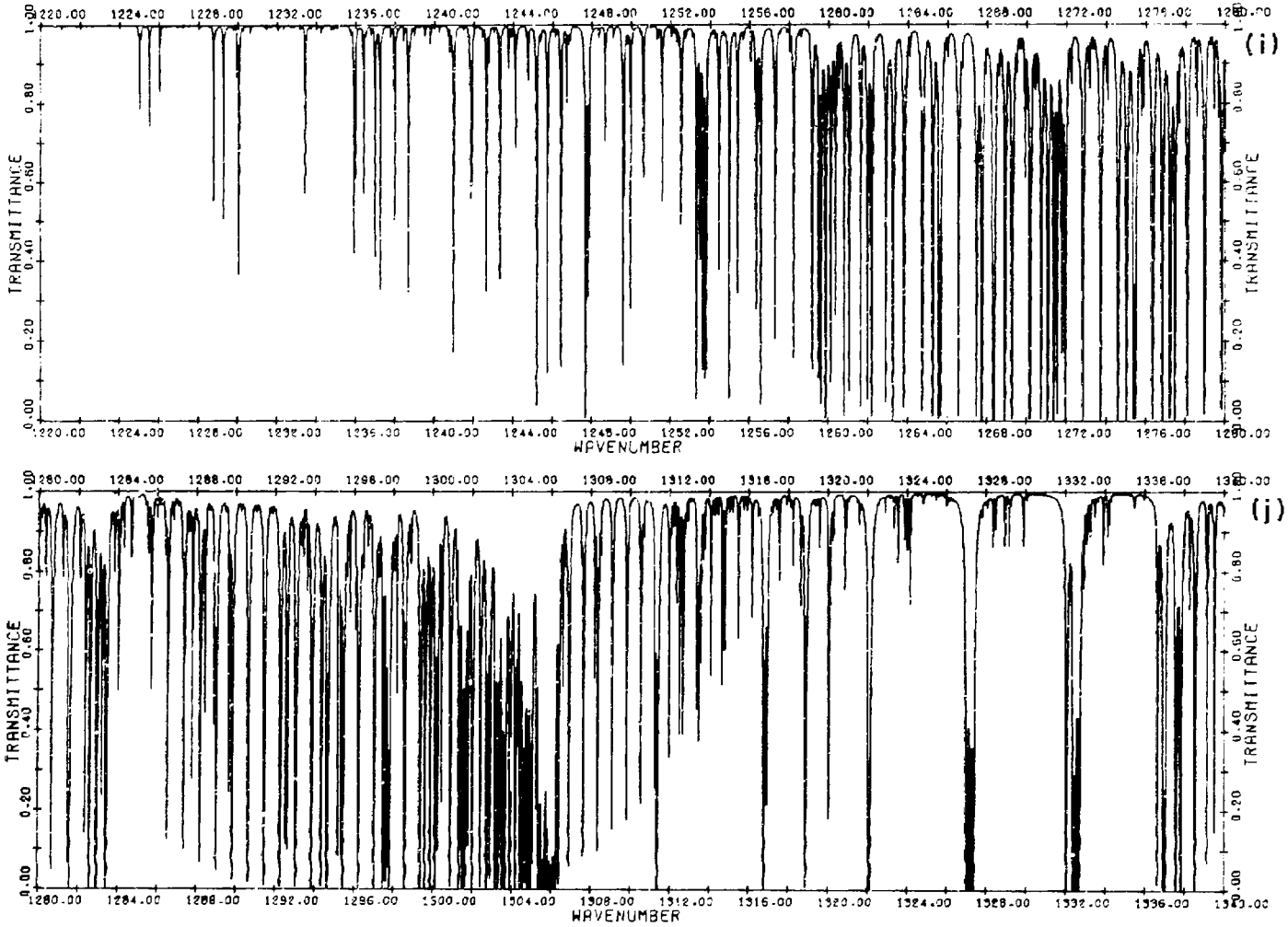


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

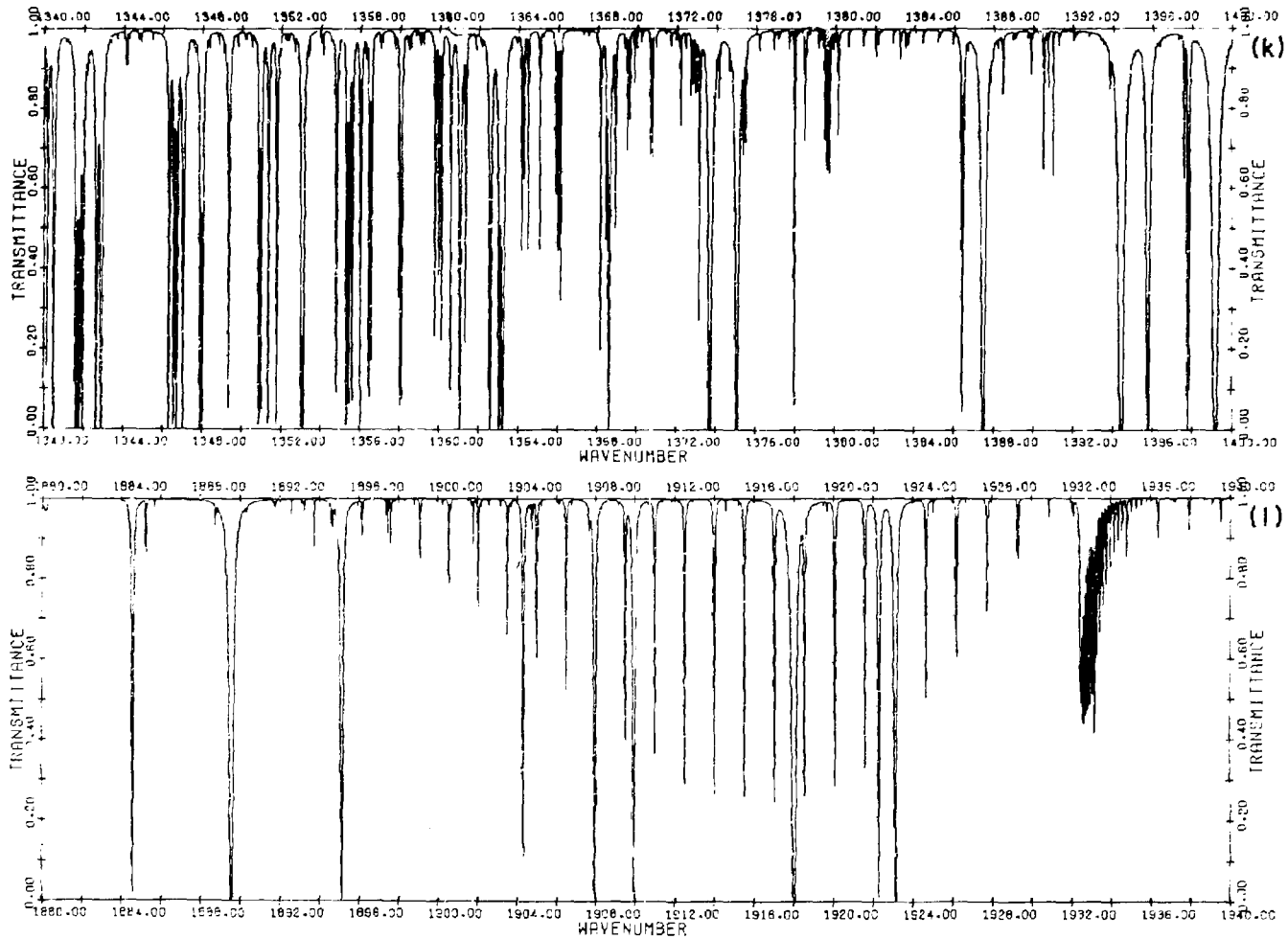


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

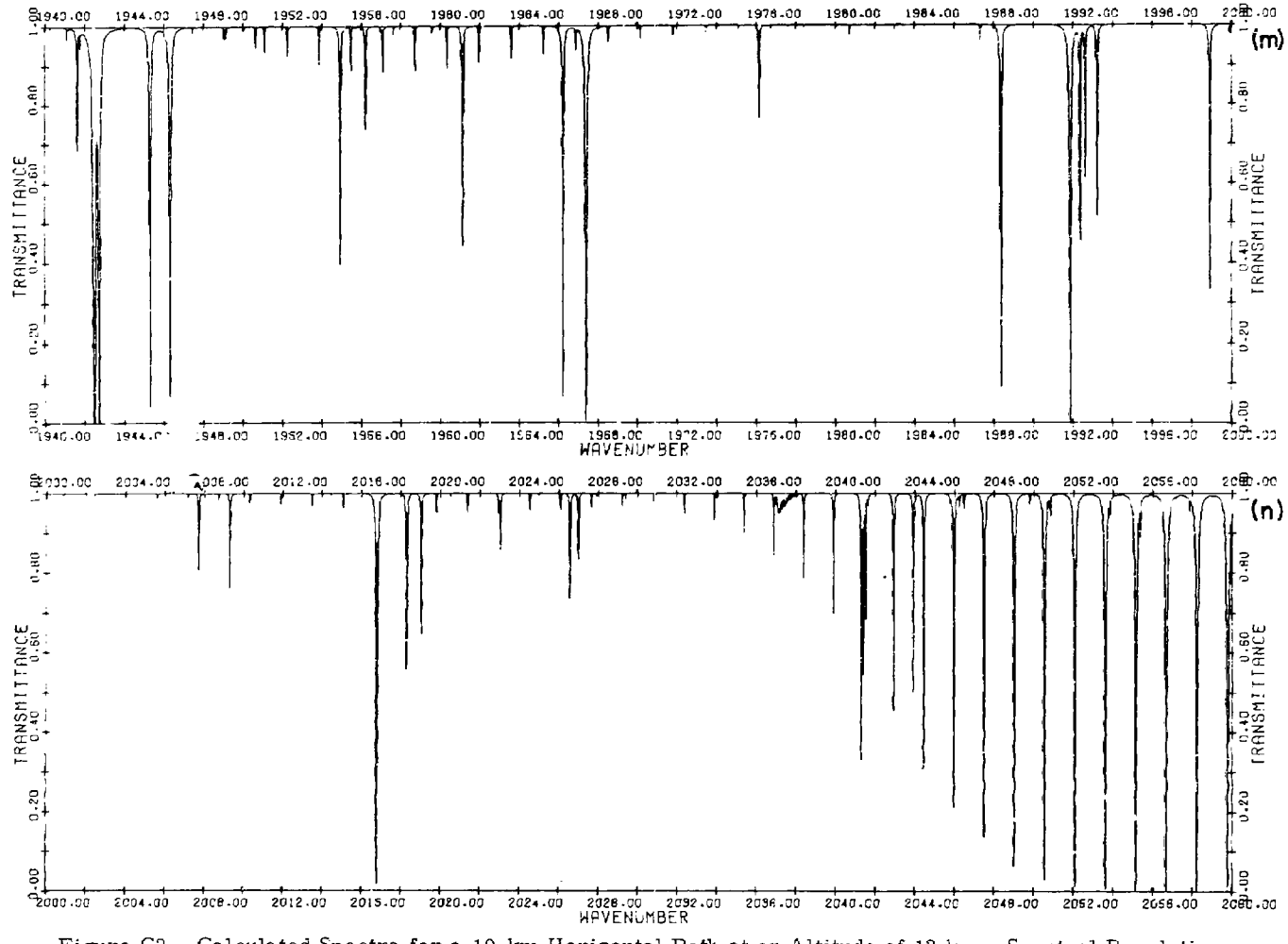


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$: Bound value = 20 $cm^{-1}$ (Cont.)

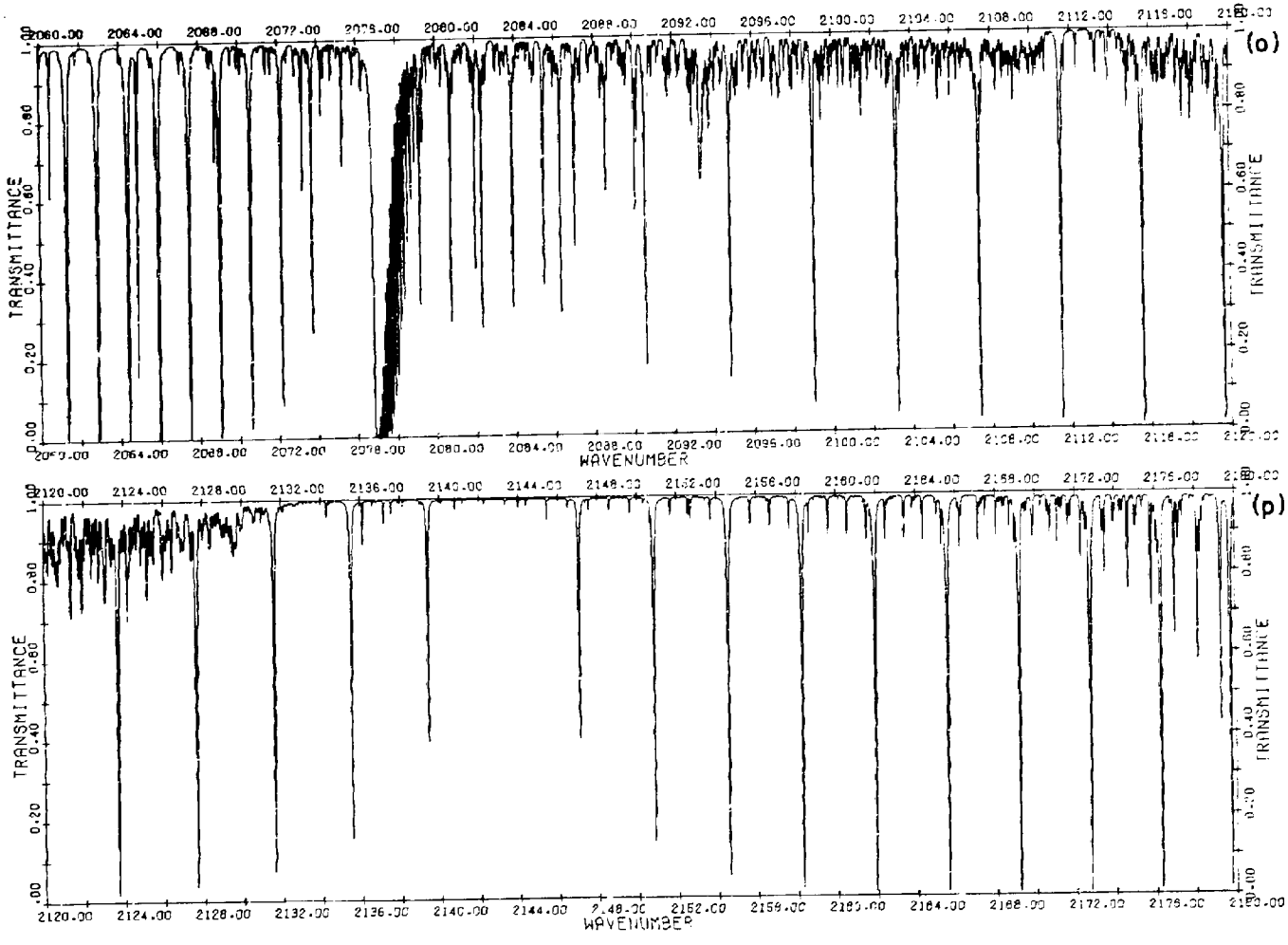


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$ (Cont.)

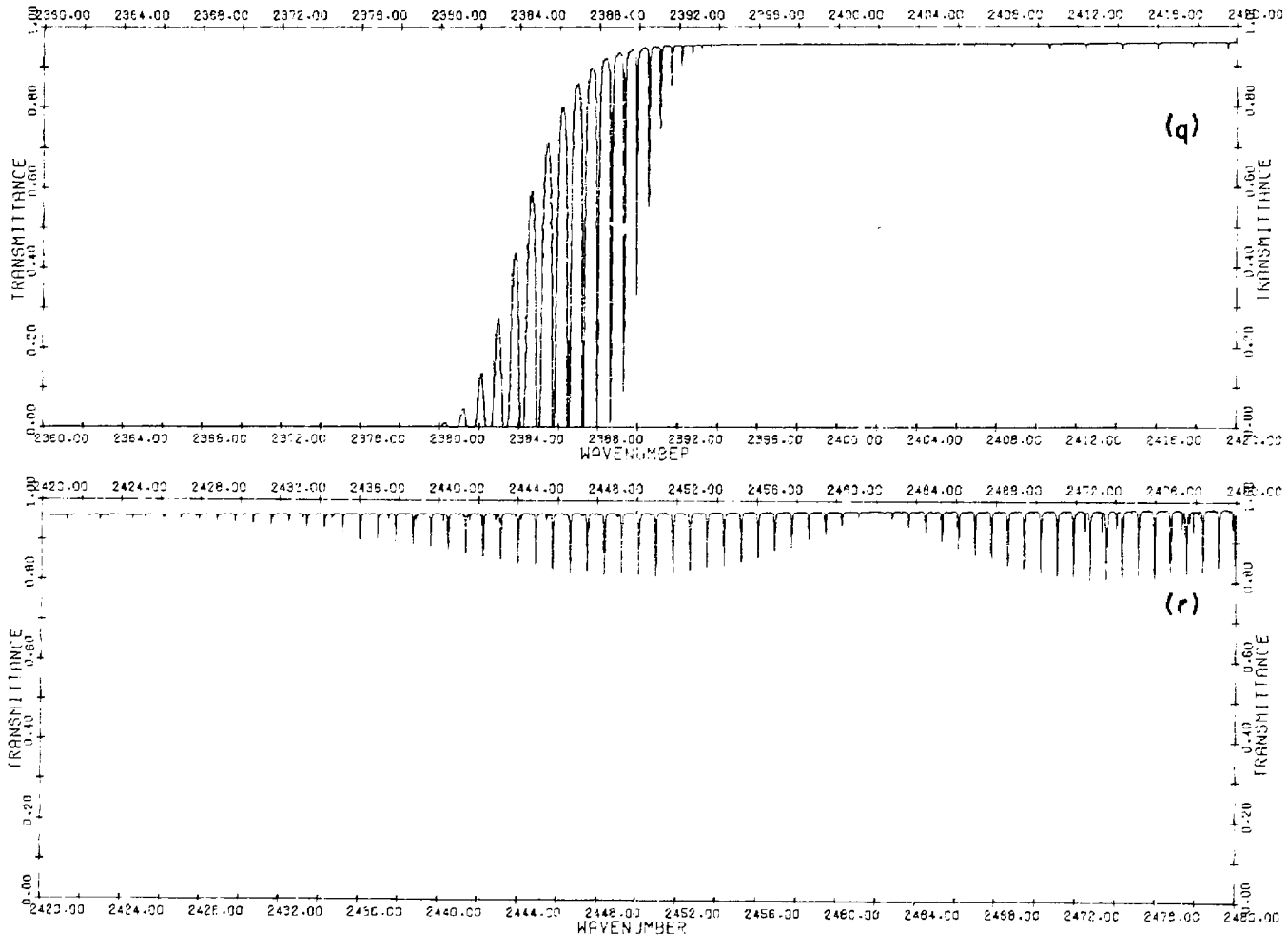


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

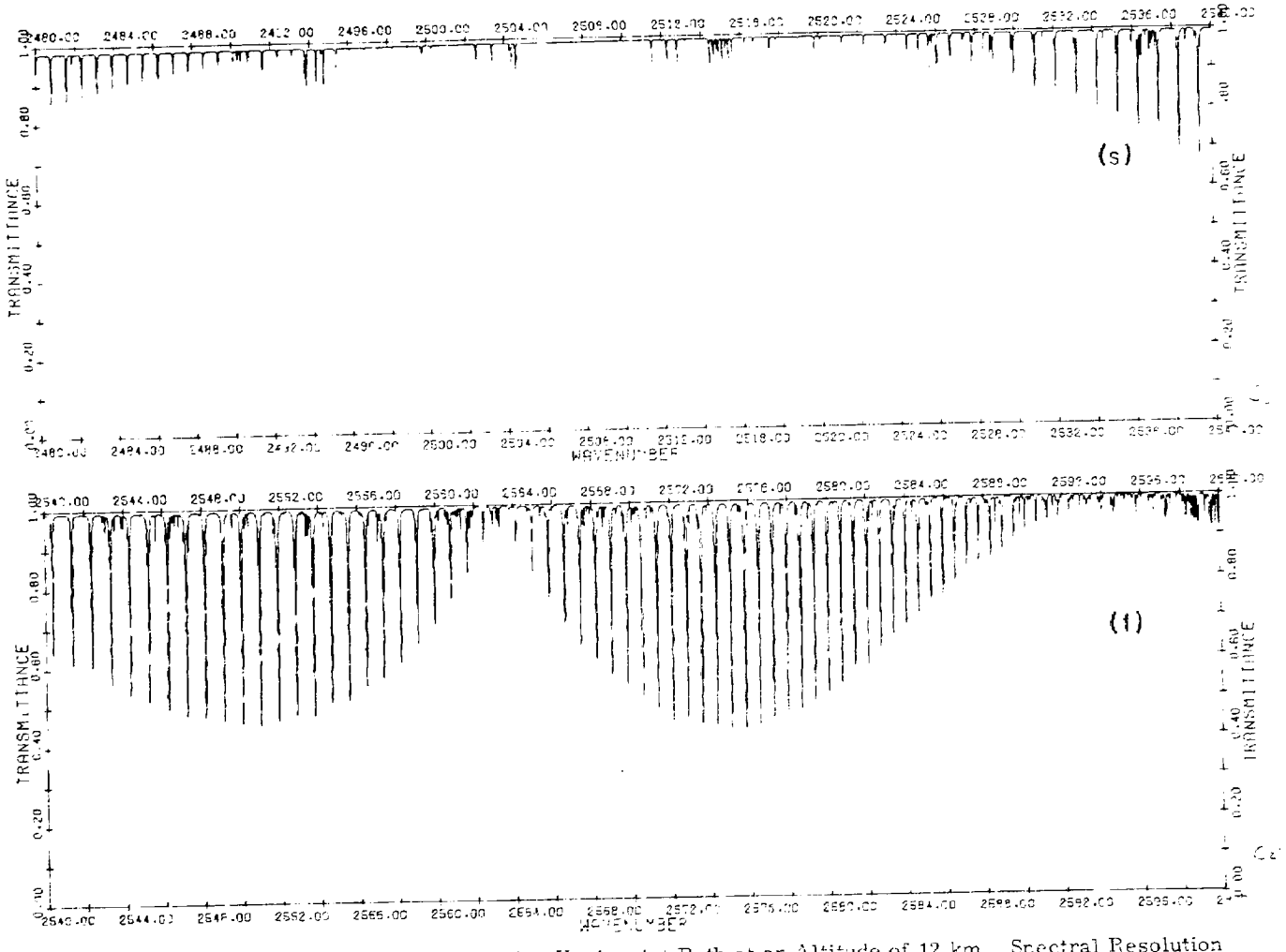


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$ (Cont.)

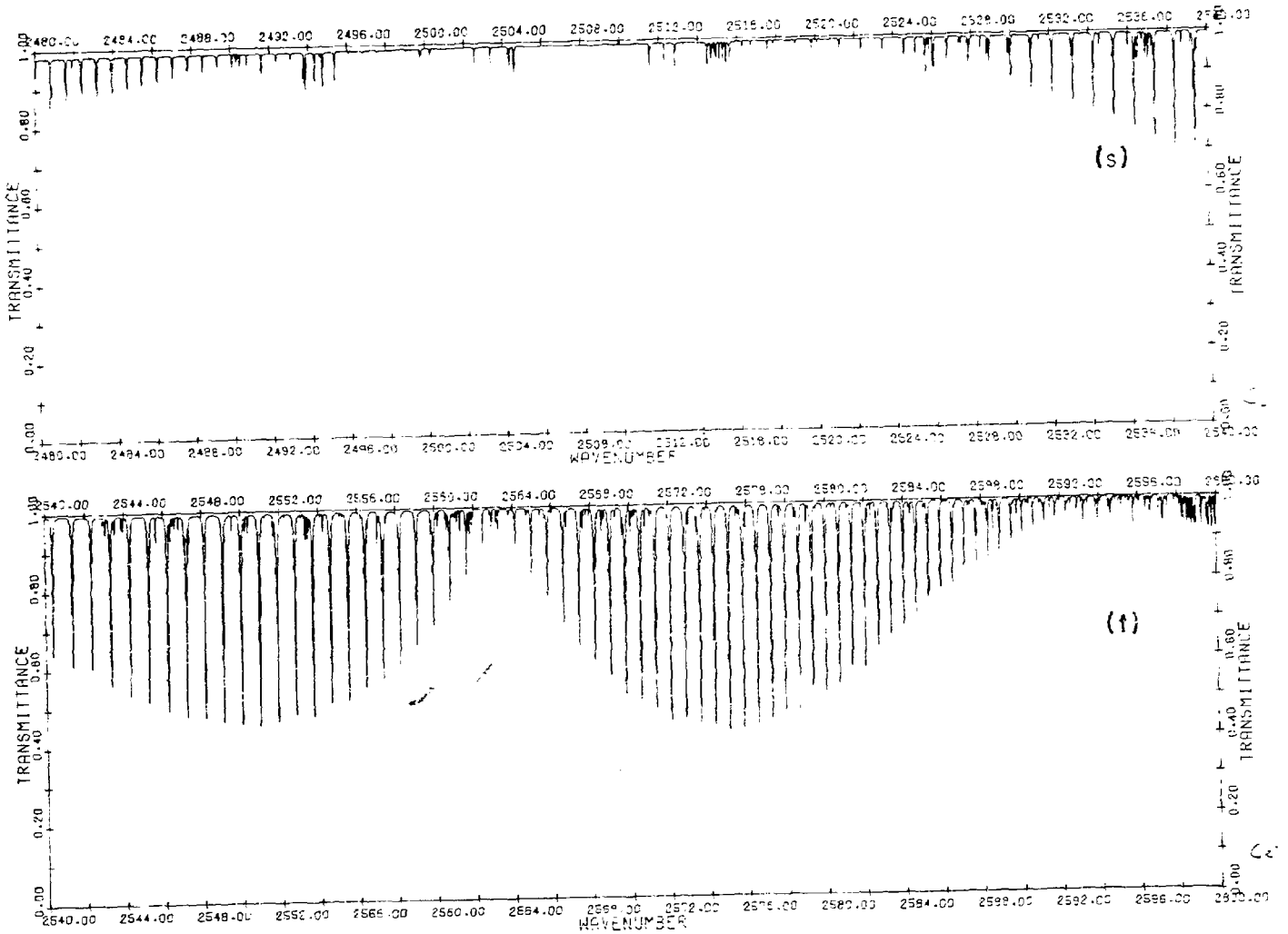


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 cm$^{-1}$: BOUND value = 20 cm$^{-1}$ (Cont.)

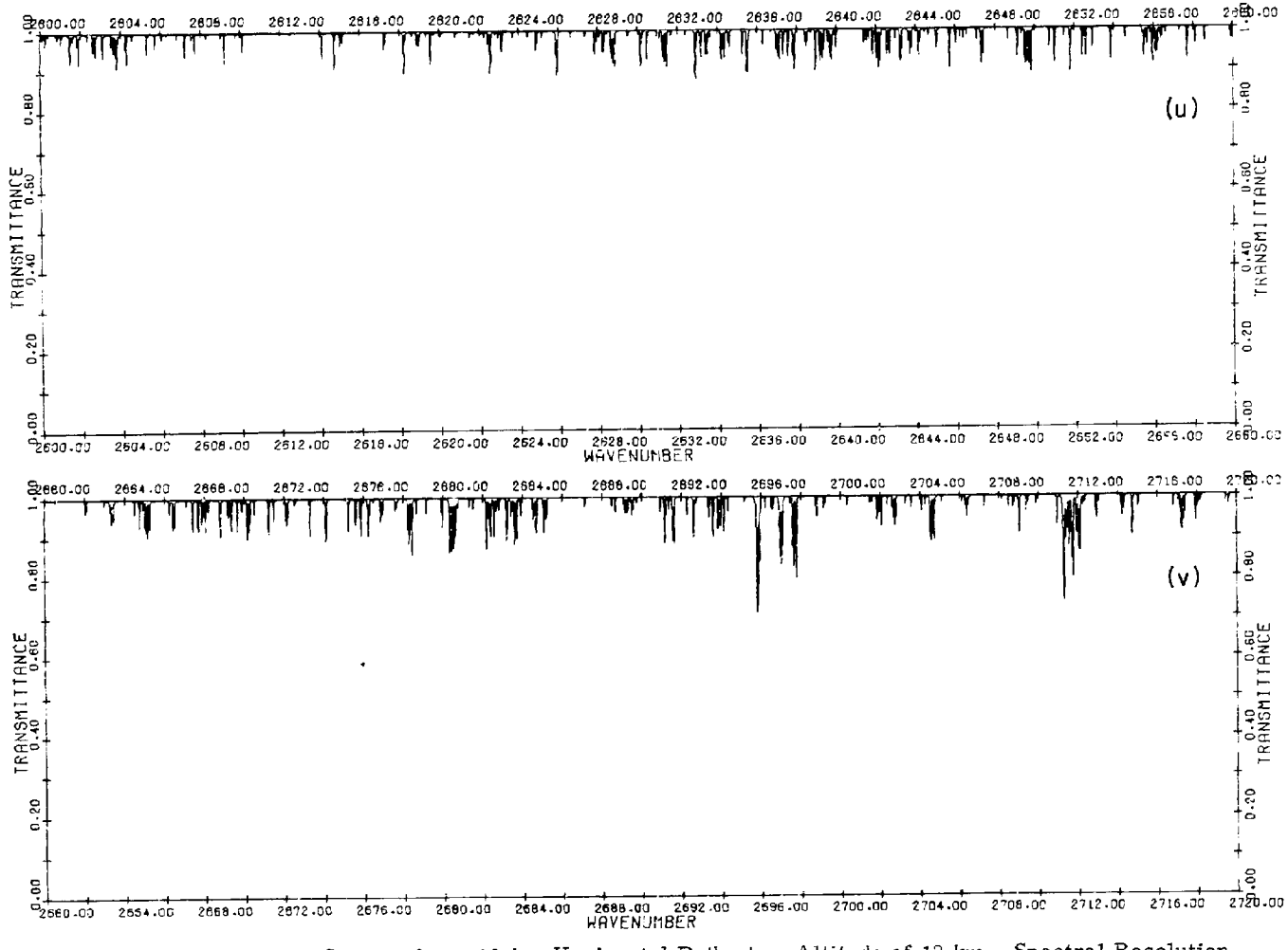


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

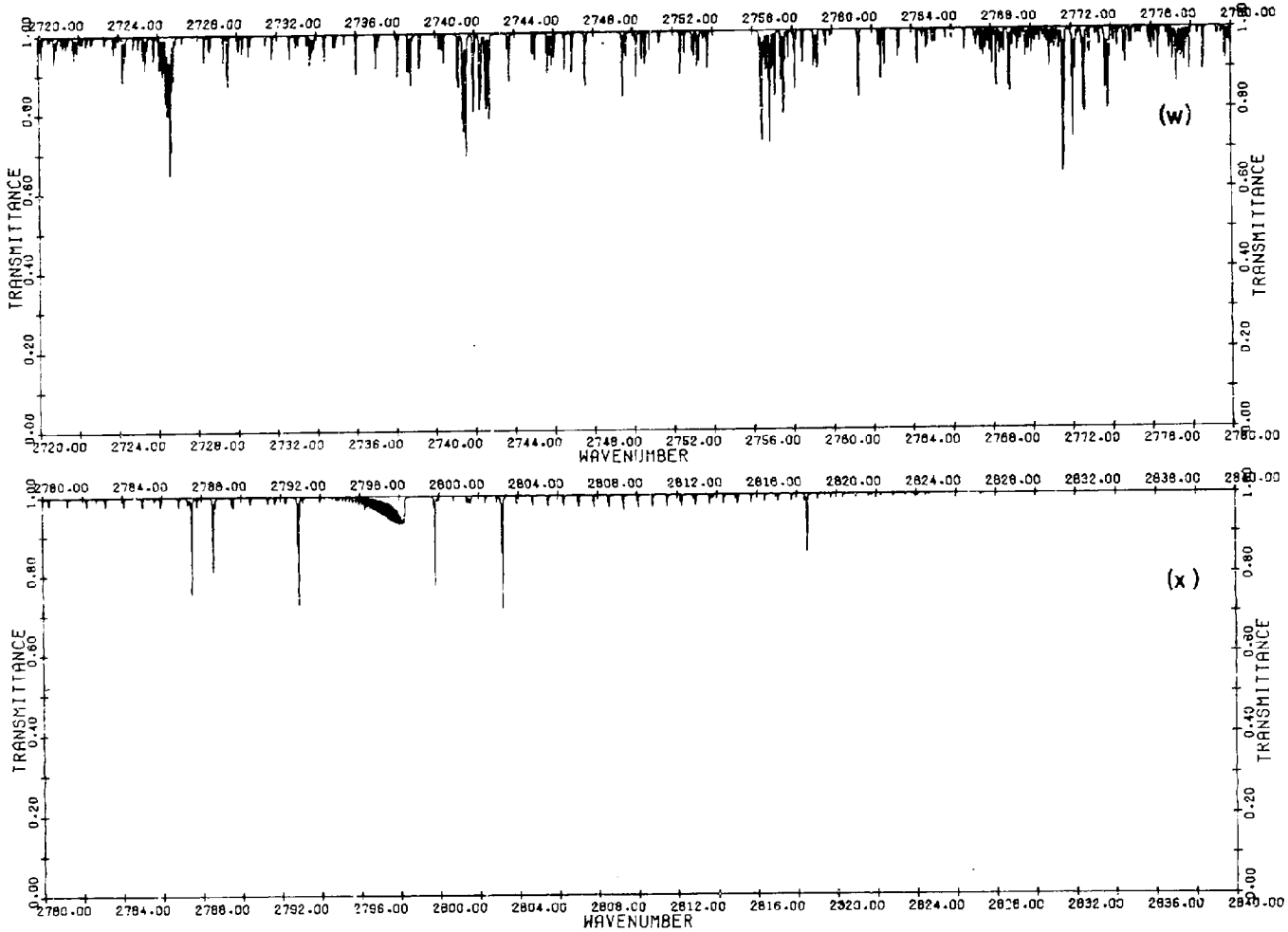


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$: BOUND value = 20 $cm^{-1}$ (Cont.)

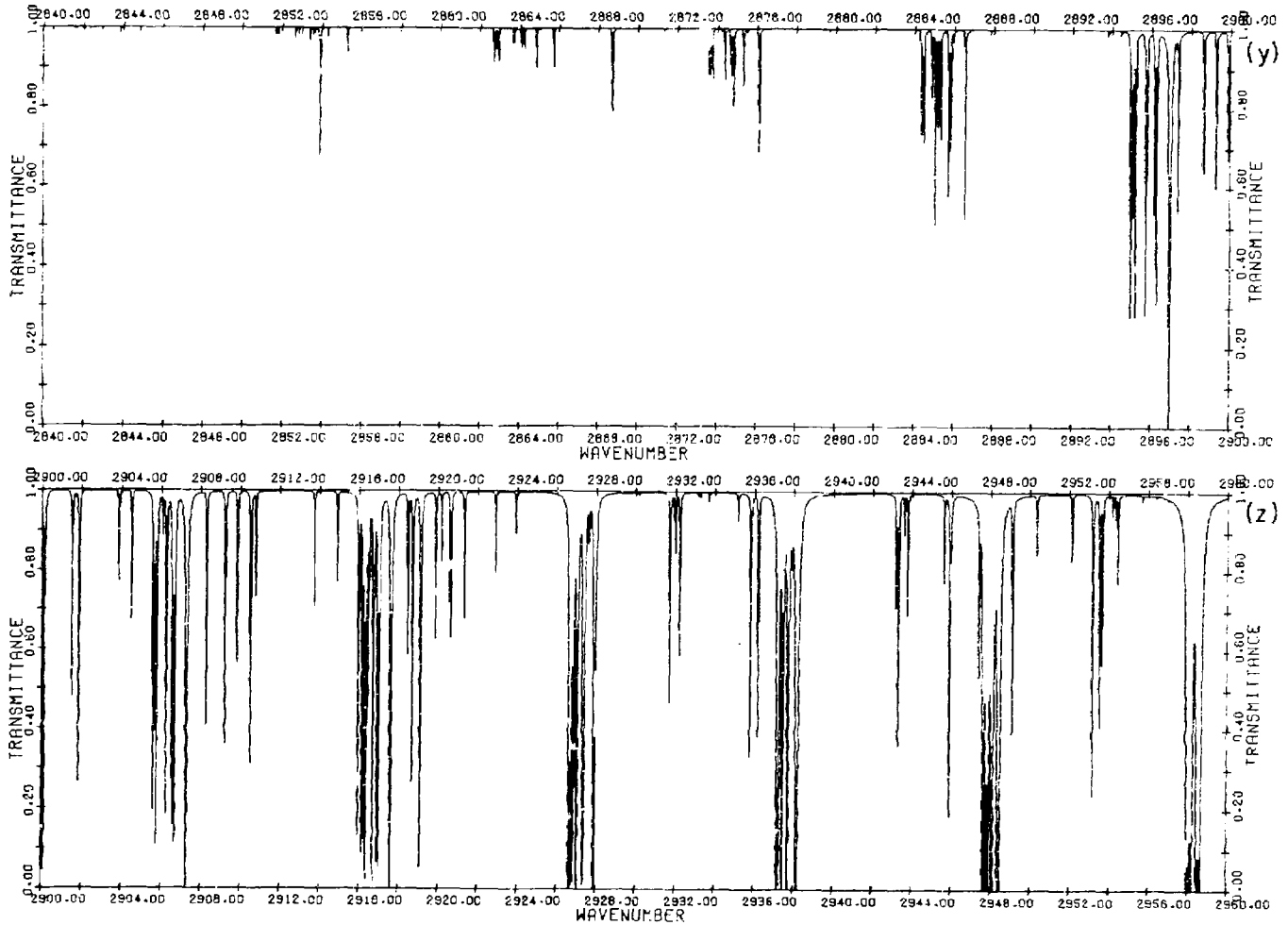


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 $cm^{-1}$; BOUND value = 20 $cm^{-1}$ (Cont.)